THE ELECTRICAL WORLD

A Weekly Review of Current Progress in Electricity and its Practical Applications

VOL. I.—No. 18. NEW YORK, MAY 5, 1883. $2 A YEAR, 5 CENTS PER COPY.

Ball's "Unipolar" Dynamo.

There seems to be something in a name after all. This is true at least so far as dynamo-electric machines are concerned. A new variety of dynamo-electric machine has lately come before the public in England and produced a sensation just on the *strength* of its name. The word is used advisedly. The fact is, the name was a little too "strong" for the English electricians, under the circumstances. The sensation aroused was not a particularly enviable one, it would seem from the many comments that come to us in the English scientific journals. The machine, by the way, is the invention of an American electrician, Mr. C. E. Ball, of this city, and it is, in consequence, of special interest to the American electrical world.

It may have some characteristic merit. Indeed, we are inclined to believe that it has more than a little, the assertions of our English friends to the contrary notwithstanding. But the rebuke which it has met in undertaking to assume a distinctive title (unipolar), the propriety of which was doubtful and, in fact, unfounded, is a deserved one in our opinion. If nothing more, it will serve to inhibit or check the somewhat prevalent American idea of catching customers with a "brand" name.

The machine has been in use in a few places in this country three or four years, and the patents of Mr. Ball date back about that time.

We are not aware that any attempts have been made to introduce the apparatus into public use to any great extent in this country, though considerable has been done with it in Canada. Those comprising the company lately formed to work Mr. Ball's inventions do not seem to be in a hurry to come forward for patronage. Perhaps they are waiting until the bread cast *across* the waters returns to them.

The invention itself is not difficult to describe. It may be said to be merely a Gramme machine of peculiar construction, with two armatures placed in a line, though revolving in opposite directions and so arranged with respect to the field magnets that only one pole-piece is presented to each armature. Fig. 1 is a diagram of an earlier type of this machine, and shows the general arrangement of the field magnets and the connections. It will be seen that the right-hand armature revolves under the influence of a pole-piece of north polarity, the south pole-piece being absent. The polarity of the lower portion of the field magnet corresponding to what would be the south pole-piece is supposed to be continuous in that arm. So that we might say the magnetic field is supposed to be made of two U magnets whose arms are of unequal length. It is supposed in this way that the armature cuts lines of force only on the half which is passing inside the pole-piece and that its other half is idle, the corresponding point on the other side of the field being "neutral," as marked in the diagram. In a later machine, in fact, as shown in Fig. 2, the space corresponding to this neutral point is covered with wire continuously.

In some of his machines Mr. Ball makes use of iron wire covered with copper to wind his armatures, which are

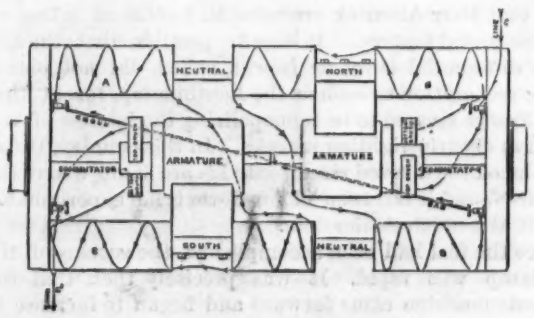


FIG 1.

then made without any iron core. In this way he pretends to disseminate the magnetic action over the whole of the wire of the convolutions of the Gramme ring, especially the wire in the inner portions of the ring, but as no comparative trials have been made, it is difficult to pronounce on the value of the improvement. It is certain that the internal resistance must be considerably greater with such an armature on account of the lower conductivity of iron.

Mr. Ball claims great advantages for his unipolar machines, all of which depend, according to him, on the unipolarity of the field acting upon each armature. It is claimed that since only one-half of the armature is in action at a time the armature will heat much less, at a given speed, and Mr. Ball maintains that he can in this way revolve his armature at a higher speed, and obtain a

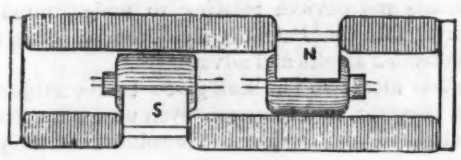


FIG. 2.

higher electromotive force than can be obtained with other dynamos. But the figures obtained by Mr. Robert Sabine, at the tests which he made of this machine in England, do not confirm this claim, however, for the electromotive force was, indeed, quite low, considering the speed. As these figures may interest electricians, we reproduce Mr. Sabine's report:

When I tested the system, the dynamo was run with six arc lamps, also said to be of Mr. Ball's invention, the dynamo being worked on the "series" system, that is to say, field-magnets, armatures and lamps all joined up in series. The speed of the machine was not so regular as could have been desired, and the Morin dynamometer, by which the power given to the dynamo was measured, would have worked steadier had it been driven quicker, or with a heavier load.

The following are the mean results which I found:

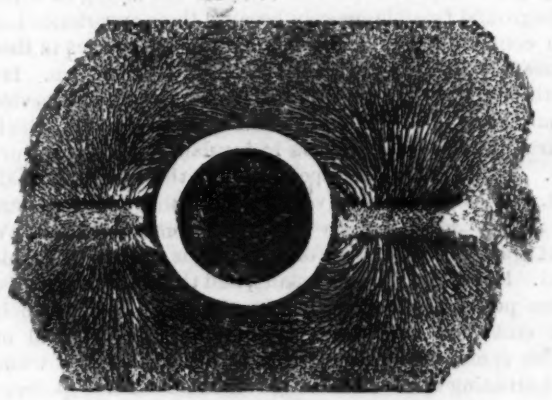


FIG. 3.

Current in circuit, $c = 15.0$ ampères.
Potential difference between terminals, $e = 195$ volts.
Resistance of dynamo, $r = 4.5$ ohms.
Speed of dynamo, 1,650 to 1,715 revolutions per minute.
Speed of dynamometer, $s = 332$ revolutions per minute.
Indicated pull on dynamometer, less pull when circuit open, $k = 52$ kilos.

From these values—

(1). Given to dynamo for electrical work,

$$\frac{1.5\ k\ s}{60 \times 76} = 5.68 \text{ h. p.}$$

(2). Accounted for in outer circuit,

$$\frac{E\ c}{746} = 3.92 \text{ h. p.}$$

(3). Accounted for in inner circuit,

$$\frac{c^2\ r}{746} = 1.35 \text{ h. p.}$$

The proportion accounted for electrically, therefore, $\frac{5.27}{5.68} = 0.92$, of which $\frac{3.92}{5.68} = 0.69$, was accounted for in the lamps. This would leave only 8 per cent. for the so-called Foucault currents.

Photometric measurements were made with one of the lamps, placed apart from the others in a dark recess, the light of the five remaining lamps not being measured.

The following mean results were obtained during the observations:

Current in lamp, 13.9 ampères.
Potential difference, 40.1 volts.

Accounted for in lamp, $\frac{13.9 \times 40.1}{746} = 0.75$ h. p.

An electromotive force of only 195 volts is certainly low for a speed of 1,750 revolutions. It has been lately shown by M. Deprez that the electromotive force is proportional to the speed up to 2,500 revolutions, but we believe that this machine will not follow the rule, and we shall endeavor to show why further on.

The greatest claim of all those made by Mr. Ball, however, is that the rotation of one armature assists that of the other. In his English patent he states that in this machine the current generated in one armature passing through the field circuit magnetizes the pole piece of the other armature, "*and by induction produces a rapid rotation of such other armature and shaft.*" These words are quoted, and from their construction the inference is that Mr. Ball is on the track of perpetual motion; for it is plain that if the current of one armature can cause the rapid rotation of the other, it is just as well to take off the belts when once the machine is started.

We agree with the English electricians, however, in considering the "unipolarity" of the machine as the most stupendous and absurd of all Mr. Ball's claims. As we just stated, there may be some benefit derived from bringing one pole nearer the armature, but where the mistake lies is in calling the thing by a wrong name. Mr. Ball appears to be under the impression that a stream of lines of magnetic force is like a stream of water, that may be run into a dish and made to *stay* there. But to the electrician who has had some experience with the behavior of lines of force this seems only absurd.

Lines of force are closed systems. It is one of their fundamental properties to form these circles. A magnet is merely a piece of metal that can condense lines of force, and "polarity" is simply the direction in which lines of force pass through this metal. In every case lines of force must form closed cycles of action. If we break the magnet in two, each piece at once becomes a portion of a smaller though equally perfect cycle. In short, the result is inevitable that if a line of force enters a piece of iron, we may expect it to come out of it somewhere, unless the iron

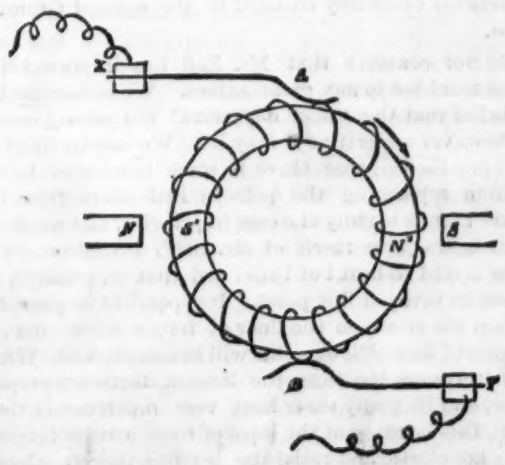


FIG. 4.

is in the form of a ring and the lines of force pass *around in a circle in that ring*, which is a condition never realized in practice. It certainly cannot be realized as long as the magnetic potential is made greater at some points by the approach of a magnetic pole, as in the dynamo-electric machine of Mr. Ball, and we must concede, therefore, that whatever lines of force enter his ring must emerge from it.

In all cases that part of the metal where the lines of force issue from it is bound to be the opposite pole of a

magnet, be it induced or permanent. Let us consider what happens in the Gramme ring. Fig. 3 shows the magnetic spectrum of a Gramme armature in its field, which is excited from a separate source. In this case the armature being motionless, acts as a simple medium of passage for the lines of force as they complete their circle between one pole and the other. The point where the lines enter, say at the top, may be supposed to be the north pole; the point where they emerge will, therefore, be the south pole. Now, if we were to remove the lower pole entirely, the lines of force would still enter at the same pole, and would still emerge from the ring *somewhere* from the surface of its remote or lower portion. Every line of force that went into the ring at one side would come out again. If there is no piece of iron there to concentrate them, they disperse themselves more or less over the whole of that half of the ring, and then emerge to complete their cycles by turning toward the remote ends of the lines of force of the magnet whence the came. So that the fact that one pole-piece is absent in the Ball machine is no proof that the lines of force are cut by only one-half of the armature. In one of those machines which we examined here, some time ago, we found evidence of a *good* magnetic field at the so-called "neutral" points of the field, and we have reason to believe that the condition will, in fact, be found the same in all his machines. Undoubtedly the lines of force disperse as they emerge, and that is why the magnetism is not so strong at any one point; but we venture to assert that the total number of lines of force which enter the "long" arm of the field at one point or another would be found equal to that of those leaving the short arm at the pole-piece.

There can be no doubt at all that both halves of the armature are in action at the same time. A glance at Fig. 4 will suffice to show this. In the Gramme ring the current moves in an opposite direction in each half. For instance, the lower brush being positive, the current passes upward in each half. Now, why does not the current generated in one half pass around through the bobbins of the other half? Simply because the electromotive forces are precisely equal in each half. Suppose, now, we were to diminish the electromotive force in one half. The result would be that the current of the other half would now overcome the current in this half, and here would be a parasite action that would rob the external circuit. Therefore we can see at once that if the Ball machine worked "by halves," all of its current would circulate around the idle half, or at least share its current between it and the external circuit.

The word "unipolar" is, therefore, inappropriate in the extreme when applied to this machine, for it is, in fact, as much a bipolar machine as any other Gramme machine. The word unipolar belongs properly to a class of machines where the lines of force are only cut in one direction, as in "Faraday's d sc." Siemens has lately produced a machine wherein a copper tube revolves around a bar magnet, and which is also more properly a unipolar machine, because each portion of the tube cuts lines of force whose polarity never changes.

We may state that Mr. Ball's idea has been anticipated in the reversed state, that is to say, when the Gramme ring is used as a motor. In the lnmp of M. Tchikoleff, which is to be found described in the present issue in No. XXV. of the articles on Electric Lighting, a small Gramme armature revolves under the influence of the magnetism of one pole-piece only. Both pole-pieces are of the same polarity, and the direction of rotation depends on the preponderance of the one or the other. In this case, the reciprocal polarity is found where the lines of force issue from the core of the armature, and this is most likely at points midway between the two poles, or where the neutral points are ordinarily situated in the normal Gramme machine.

We do not consider that Mr. Ball has improved the Gramme machine to any great extent. We rather incline to the belief that the "new departure" is a wrong one in itself, however suggestive it may be. We are inclined to think, nevertheless, that there is some benefit to be derived from separating the poles a little more from the armature than is usually the case in practice, and we think that this is the sole merit of Mr. Ball's invention. The machine is said to heat but little, and that is, perhaps, an argument in favor of this point. It appears to us plausible that when the strain on the lines of forces is lessened the occurrence of Foucault currents will be less marked. When the armatures are too close the lines of force are pressed together, and in many cases bent very much out of their course. This bending of the lines of force causes tension, for they are elastic and resist the bending power. Consequently the deviation consumes energy, without return, and therein may be the secret of much internal heat occasioned from the recoil of the lines of force in the molecules of the core. When the armature is removed further from the pole-piece the lines of force are less constrained and merge into the core more naturally, so to speak. But evidently, if there is any value in this theory, the best appreciation of it would not be to dispense with either pole-piece, but to place them both at an equal distance from the armature. The comparatively low electromotive force for the high speed is explained by the fact that the field of such a machine is less stable. So that, after all, it is a question how much real benefit there would be in this change, since it would allow the field to be rotated forward as the speed increases, in the manner explained by M. Deprez. The fact is, with a field necessarily more unstable or less tense than that of Mr. Ball's, the rotation indicated by M. Deprez begins sooner, and the limit of proportional increase of electromotive force and speed is reached much sooner. The field could be condensed by using more iron in the armature cores, but this would make its reaction on the field all the greater.

Underground Systems.

There are many electricians and inventors in the country who lament their misfortune in having come "too late" to share in the fame and fortune which have followed the rise of the telephone and the electric light, who will be delighted to turn their energies to a problem where there is an excellent chance to achieve something great and valuable. They have been literally looking about for something to work on, and this is precisely the opportunity they desire. Some of them have even already gone to work, and the procession of those who will follow in their footsteps promises to be large. The American inventor is so wide-awake and his mind is so full of expedients and practical ideas that, as a rule, it does not take him long to evolve something. We have a good illustration of this in electric lighting, and in the hundreds of American inventions which it has called forth in less than a half dozen years.

The underground system is now placed before his attention. He knows what is needed, and he will at once endeavor to produce it. Forthwith we shall find a torrent of ideas, schemes and devices relating to underground systems pouring into the Patent Office from all sides, each with its pretended merits and advantages.

More or less attention has been given to the subject, of late years, however, and there are even now some inventors who claim to hold the key to the solution of the problem.

An underground conduit for electrical wires is at present in course of construction in Chicago, which Mr. J. E. Fuller, who is laying it, claims to be a satisfactory solution of the underground problem.

No definite and precise description of this system of underground communication has yet been obtainable, but it may be said to consist substantially of a metallic conduit more or less spacious in which the wires intended to convey the currents of various kinds are to be carried. It is after the pattern of the Paris conduits, only its walls are metallic, doubtless for the purpose of better protection and of eliminating inductive effects, though it would seem as if the protection in the latter instance would be rather inadequate and doubtful. Mr. Fuller has great confidence in his project, however. He proposes to run all the wires singly, side by side, each being highly insulated, separately, and it is in this respect that he claims to obviate some very important objections that have made underground systems impractical. According to Mr. Fuller, the telephone and telegraph companies do not consider the laying of wires underground feasible, merely because their experience has been confined to cables alone, which he disparages in this connection as an impractical and ephemeral plan. He asserts that very few cables have rendered good service for any length of time, on account of the troubles which invariably arise from defects in insulation and construction. The use of a lead pipe to protect the wires is considered, in his opinion, to be very objectionable, because there are always some defects in the lead covering, and in a short time the insulation of the wires is apt to fail at this point. Hence the need of repairs, and the result is that the cables prove very expensive in the end, even if their first cost was comparatively small. A great deal of trouble comes from air bubbles retained in the pipe while the insulating material is being forced in. These globules take up moisture and soon voltaic action is brought about between some of the copper wires and the lead pipe covering them, with the ultimate result of making a "fault" in the cable which renders its further use impossible. Then the cable must be overhauled, at great inconvenience to the public, since it necessitates disturbances of the street pavements, and at an expense which is very undesirable to the companies. According to Mr. Fuller, the only question there was to be solved in the conduit which he is now laying and which he advocates, is that of insulation, and he says it was soon disposed of, as may be inferred from his assertion that there are a half-dozen kinds of wire readily obtainable in the market which will work in a metallic conduit without the slightest difficulty from induction or retardation. He expresses great confidence in the general adoption of his system, and has no doubt of its applicability to the needs of an ideal system, which can convey currents of all kinds without causing any reactive disturbances in the contiguous conductors.

The system is being laid as a business enterprise and will be opened to all desiring its facilities. It will either rent conductors all laid, or space wherein the conductors may be laid, as preferred by those patronizing the system. In fact, the system is one that cuts the grass from under the feet of the various companies requiring its facilities, and it shows that the companies in other cities who would prefer, as they naturally must, to own such a system themselves must hurry in adopting the example of the New York companies. That is to say, they must make haste to take action in the matter. In the absence of initiative at Chicago on the part of the companies interested, this private action will be of great convenience. As Mr. Fuller says: "We will be able to give them all a safe, cheap and excellent resting place for their wires if they wish to comply with the city ordinance, and save them money enough by the greatly lessened cost of maintenance to repay them for their overhead system, the wires and poles of which they can still use above ground outside the city limits."

The conduit is now being laid on La Salle street and is progressing northward rapidly. This section is being laid first for the accommodation of the Postal Telegraph Company, which is placing in it two Patterson cables of twenty wires each. These are expected to be at Washington street by May 10.

Contracts for renting other wires to be laid on shelves in the same conduit are now pending.

The owners of the conduit do not agree to keep the cables in repair, but simply to give the company laying them ample facilities for so doing or for replacing any section that they may desire between the working pits and testing stations or for making house or office connections anywhere without tearing up any portion of the street. It is proposed to give a public demonstration in a few days to test the workings of the system for the satisfaction of the telegraph and other companies who desire to be convinced of its merits. Elaborate arrangements are being made for this demonstration. There will be circuits of four miles for electric lights, and from one to ten miles of telephone and telegraph wires, highly insulated, with batteries attached, lying upon copper shelves in the conduit. A large number of electricians and scientists from all over the country, including several delegations from City Councils of other cities will be present. All companies interested in electricity have been invited to take part in the tests.

The claims of Mr. Fuller, if they are substantiated, will encourage the companies in other cities to take more immediate measures for placing their conductors underground, because the success of this system, or even an approach to success, will show that the remedy is nearer at hand than was supposed.

There is another system which is being talked of in Chicago for underground telegraph conductors.

It is being promoted by the Air Chamber Wire Insulating Company of that city, and is the invention of Mr. J. F. Martin, who has secured quite a number of patents in this country and has other applications pending in Washington and abroad. No complete details of this system can be obtained until the company has secured its patents, but a general idea of the system may be given as follows:

The wires are insulated with a combination of petroleum and other materials to make the mixture durable, there being nothing in the composition that will decompose. The wires are placed in tubes, which are covered with tile-pipe large enough to permit the circulation of air in order to offset the effect of gases in the ground. The system not only requires little tearing up of streets, but meets the wants of telephone and private wires, the wires to be run to posts to be placed in alleys, whence they are distributed to the buildings.

No doubt these two systems will soon be followed by others which will come forward to compete for the prize that awaits a good, practical, complete underground system.

Electric Lighting.—XXV.

DIFFERENTIAL ARC LAMPS.

As already stated, the successful career of the arc light began with the introduction of the method of regulating the arc by a derived circuit, for it was only by this means that the long-desired possibility of operating several lights on one circuit from a single source of current was attained. It may be said that previous to the year 1876 this important principle was unknown, because—while it is possible and indeed probable that it was then in the mind of some men—nothing had become publicly known about it. It was first heard of in France from M. Lontin, in the improved Serrin lamp, and shortly afterward from Von Hefner Alteneck in the Siemens lamp. It has been claimed since that Herr Alteneck preceded M. Lontin in introducing this useful feature. It is quite possible that the Siemens differential lamp, as it was called, did not obtain public recognition as soon as the Lontin lamp, for at that time France seemed to be monopolizing the interest of the world in electric lighting matters. In this country, Brush introduced the derived circuit into his arc lamp about the year 1877, and it has been claimed that he experimented with it at a much earlier date.

Once the feat had been accomplished, the success of the arc lamp was rapid. It was precisely then that the Gramme machine came forward and began to increase in variety and number, as if it had been waiting for this "missing link" to begin its career of activity. The idea of using the differential action between two circuits was as simple as it was practical, and it was not long before its adoption by inventors generally brought a large number of new and efficient lamps before the public. The principle is such an easy and such a simple one—a mere deduction in fact—that it is no wonder it originated inde-

pendently in several minds. It may be wondered, in fact that it was not discovered on more occasions by those engaged in perfecting the arc lamp. The strangest circumstance of all, however. in this connection, is that it should have been brought forward and then apparently forgotten for more than twenty years. Had this early achievement received the attention which its importance deserved, and had it become generally known, there is no doubt whatever that other inventors would have given us, even at that early day, the beginning of those wonderful improvements which are coming before us only at this present time.

LACASSAGNE AND THIERS.

It is to the combined genius and application of these two men that the principle above mentioned owes its first conception and its first application. In the year 1855 they produced an electric lamp, which was a perfect marvel of simplicity in construction, and which embodied the differential principle of regulation. This lamp has received more attention of late than it probably did at the time it was brought out, simply on account of the fact that it is the earliest instance of differential action introduced into arc lamps. Some of the inventors who have subsequently re-discovered this principle have obtained patents more or less broad upon it, and it is in connection with matters of patent infringement and litigation that it is destined to play an important part. No doubt a good deal of reliance is to be placed upon this invention, in cases where it is desired to annul the claims of subsequent patents that cover this principle broadly, by its serving to place the question of novelty in a better light. But there is, nevertheless, a limit to the scope of this invention in this respect,

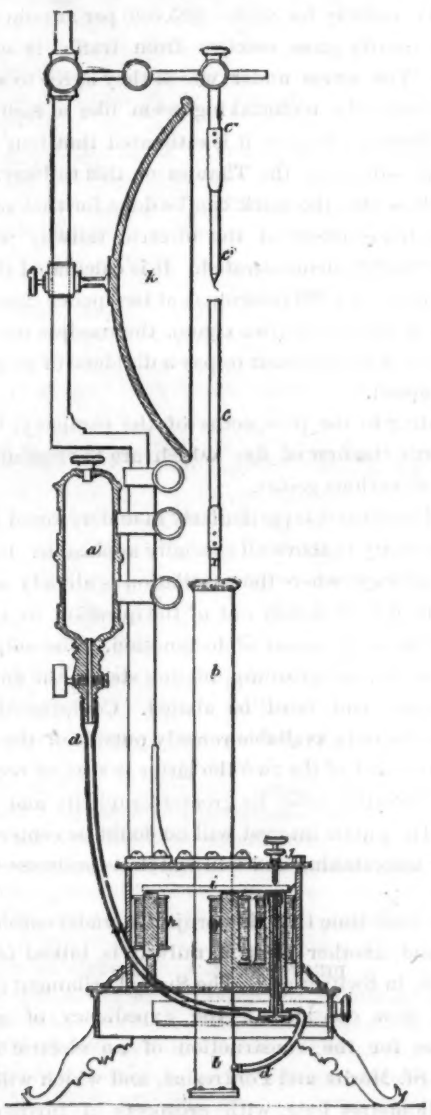


FIG. 79.

just as there has been found one to that of the Pacinotti machine as an invention anticipating the Gramme machine.

The lamp, as shown by a fac-simile of the drawing accompanying the French patent taken out by the inventors, (Fig.79.) consisted of a frame standing on short legs and carrying a standard, to which the reflector *k* was secured, and also a horizontal arm at its upper end, to which the upper carbon clamp *c* was fastened. It appears from this that the upper carbon was not movable at all, which is a point to be remembered. The lower carbon *c* was attached to a rod *x* playing inside of a cylinder *b b*. This cylinder was connected at the bottom with a small flexible pipe *d d* that led to a reservoir *a* fastened to the standard. On its way to the reservoir this pipe makes a loop or turn upward, so that any fluid placed in the reservoir would pass up in one branch of this loop and down the other on its way to the cylinder. At the top of this loop there is a valve *f* for closing the opening in the tube and preventing the flow. This valve is attached to the oscillating armature *i* and moves up and down with varying degrees of attraction of this armature, the extent of motion being regulated by a screw *j*. The armature oscillates on a pivot at about its centre. It is made T shaped and is controlled by two magnets, which are shown in section, the one at one end *g*, which is seen sidewise, being wound with coarse wire and placed in the main circuit. The electro-magnet *h*, which is seen edgewise, is wound with very fine wire, one end of which connects with the upper carbon holder, while the other end connects with the lower carbon holder, so that it is in a derived circuit. The reservoir *a* was filled with mercury and raised high enough, so that the mercury would tend to rise in the cylinder *b* whenever the valve was raised so as to allow the free passage of mercury through the tube *d*. The lower carbon rod *x* floated in the mercury, and, of course, tended to rise upward as the mercury rose. Thus it will be seen that the motive power was obtained without clockwork or mechanism of any kind, it being merely the result of a higher

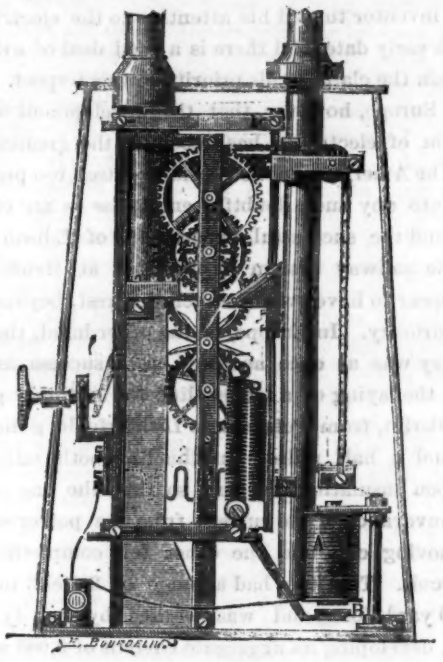


FIG. 80.

level of the mercury in the reservoir *a*. When no current passed, the valve was open and the mercury flowed into the cylinder until the carbons touched. The lamp would not start itself, for—as pointed out above—the upper carbon was practically stationary, and there was no mechanism for causing the lower carbon to separate. So, in order to form the arc, it was necessary to separate the carbons by hand, by moving one or the other.

Once the arc was established, the regulation was automatic. The current passed through the main magnet *g*, and closed the valve *f*, thus stopping the flow of mercury, and, consequently, the carbons did not move apart. But the shunt magnet *h* pulling on the other end of the armature tended to open the valve. The shunt magnet was wound with fine wire, and had a very high resistance, but the greater number of turns of the wire on the core gave it sufficient power to act on the armature. As the arc lengthened, its resistance increased; consequently a little more of the current passed through the shunt circuit magnet, and soon the

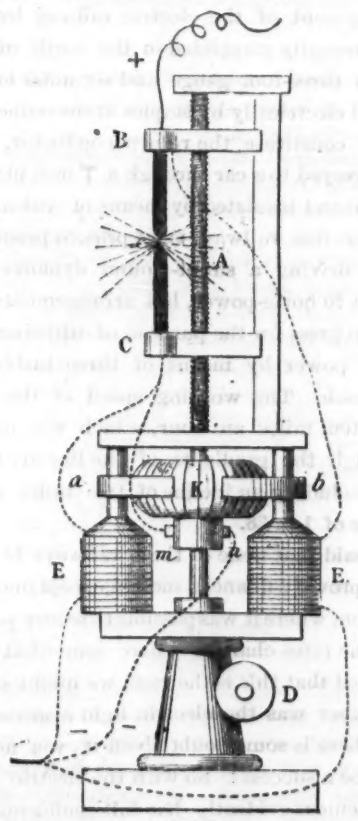


Fig. 1.

FIG. 81.

diversion of current increased to a sufficient degree to tilt the armature and to open the valve a little, so as to cause the lower carbon to feed upward. There was evidently a point where the resistance of the arc was such that it would cause just enough current to pass through the shunt circuit magnet to counterbalance the main circuit magnet, so as to leave the valve opened to an extent sufficient to allow the carbon to feed at the proper rate. It is seen that in this way the lamp maintained a steady arc irrespective of the strength of the main current. It fed without waiting until the current had weakened in the whole circuit, and this, just because it had a method of counteracting the main circuit magnet at the required time. Two, three, or any number of such lamps could undoubtedly be worked in series. When once the arc was established by hand in each, they would regulate themselves automatically with great precision. The inventors probably never tried to run two such lamps together, and presumably never even dreamed of the great possibility of their invention. The idea of regulating lamps by liquids in this way has been taken up of late years with much success. Several lamps of this sort have appeared, which apply the principle in an interesting manner. It may be well to notice what little would have sufficed to make this lamp a practical one. The addition of a main circuit solenoid around the cylinder *b*, by acting on a carbon holder of iron somewhat as in the Gaiffe lamp, would have made it start itself automatically; and it would be an easy matter to reverse the mechanism so as to inclose it in a more condensed space at the top, thereby improving the appearance of the lamp.

LONTIN.

Once the idea of differential action is understood, then the study of arc lamps of the recent patterns becomes a simple matter of detail. In all cases we find that a shunt circuit solenoid or magnet is brought into play to cause the feeding of the carbons at the right moment. The improved Serrin lamp of M. Lontin perhaps deserves special mention, inasmuch as M. Lontin is one of the fathers of the differential principle. It is shown in Fig. 80. In this lamp the magnet was wound with fine wire and placed in the shunt circuit. The escapement of the mechanism was so arranged that it was released instead of being locked when the armature was attracted, so that once the normal arc established, any further lengthening of it caused the magnet to pull the vertical rod carrying the triangular lock to release the escapement. In other respects the lamp had the same general appearance of the Suisse-Serrin lamp.

TCHIKOLEFF.

The report of the discovery of M. Lontin led M. Tchikoleff to come forward with his claims to priority. M. Tchikoleff, who was chief of the electric lighting service of the Russian Artillery, claimed, in a letter to *La Lumière Electrique*, in the early part of the year 1880, to have been the first to think of the application of the differential principle. In this letter he states that he first applied it to a Foucault lamp in 1869, by substituting a shunt magnet for the spring that counteracted the main circuit magnet. He found that when thus improved the lamps would give a steady light with a smaller battery than those regulated imperfectly, and he states that he could produce a satisfactory light with 24, or even 20, Bunsen elements with his improved regulator, while it required at least 40 to work the Foucault or Serrin lamps. M. Tchikoleff determined then to construct an entirely new lamp, free from all mechanical complication, and which would be adapted to the requirements of the service. In the year 1871 he brought his new lamp before the Moscow Society of Naturalists. In this lamp a little magnetic motor was worked by the derived current. An oscillating armature carried two systems of gearing, and this armature was controlled by two magnets working "differentially," so that one system of gearing was brought against the pinion on the axis of the motor, thus causing the carbons to separate, and this was then exchanged for the other by the inclination of the armature whenever the arc became too long. The lamp shown in Fig 81 was designed in 1874 and exhibited to the Moscow society in the same year. A small ring armature *K*, of the Gramme or Siemens type, revolves on a vertical shaft, the upper portion of which *A*, has a right and left-hand thread, so that as it rotates the carbon holders *B C*, into which it screws, either move apart or else come together, according to the direction of rotation. The armature is intended to work as a motor, and it is placed in the main circuit, as shown by the dotted lines connecting with the commutator brushes *m n*. One side of the field *E* is also in the main circuit, the current dividing between it and the armature. The other side of the field magnet is in the derived circuit of the arc. The current passes in such a way that both the pole pieces *a b* are of the same polarity, and, consequently, when they are both of the same strength, they counteract each other as to the effect on the armature, and the armature remains stationary. If the carbons are in contact on passing the current, there is little or no current in the shunt circuit, and consequently the field magnet *E*. exerts no influence on the armature. The magnet *E*, however, is as strong as ever, and consequently the armature revolves under the influence of the magnetism from the pole-piece *a*. As the arc lengthens, more current is diverted into the shunt circuit *E*., and the armature moves more slowly, until it stops after the counterbalance between the two pole-pieces is obtained. On the other hand, if the arc becomes too long, the magnetism of the shunt-circuit magnet *E*. overpowers that of the main circuit, and the armature revolves in the other direction, which causes the carbons to move together. A screw *D* is used to regulate the distance by hand, if desired.

C. O. M.

THE

ELECTRICAL WORLD,

PUBLISHED WEEKLY AT

No. 9 MURRAY STREET, NEW YORK.

W. J. JOHNSTON, Editor and Publisher.

NEW YORK, MAY 5, 1883.

CONTENTS.

ILLUSTRATED ARTICLES: PAGE.
Ball's Unipolar Dynamo 273
Electric Lighting, XXV 274
EDITORIAL:
Electric Railways 276
Postal Telephony 277
Latest Development of the Telephone 277
Electricity and its Relation to the Senses 277
Both Sides of the Question 277
Earth Currents 277
French Academy Prizes 277
Success of Our New Departure 277
Patent Decision 277
Some Cases in Point 277
MISCELLANEOUS:
Underground Systems 274
The Color of Sound 278
A Model Establishment 278
Flirting by Telephone 278
Electric Service in Every Day Life 279
Electrical Resistance of Copper Wire 279
Enlightening a Colored Man 279
Electrical Time Service in Ohio 279
DEPARTMENTS:
The Telegraph 279
The Telephone 279
The Electric Light 279
Miscellaneous Notes 280
Department of Inquiries 280
Electrical Patents Issued 280
Business Notices 280

NEW ADVERTISEMENTS.

PAGE.
CORNELL UNIVERSITY—Courses in Electrical Engineering, Mechanical Engineering, etc 281
"ELECTRICIAN"—Situation Wanted 281
GEORGE WHIPPLE—Electric Light, Telephone, Telegraph and Miscellaneous Stocks 281
THE TIME TELEGRAPH COMPANY—Standard Time 281
G. C. SCOTT—Home-Made Turkish Rugs 281
FARM, FIELD AND FIRESIDE—$40,000 in Presents Given Away 281
DANIEL F. BEATTY—Organs 282
WORLD MANUFACTURING COMPANY—New American Dictionary 282
JEROME KIDDER MANUFACTURING COMPANY—Electro-Medical Apparatuses 284

ELECTRIC RAILWAYS.

There is nowhere to be found a better proof of evolution in science than in the rapid progress which has taken place in the transmission of power to a distance by electricity. We might even go further and say the progress of the electric railway, for it is here particularly that the recent development in the transmission of power by electricity is found embodied. As the territory of invention and application grows narrower in one branch of our science, new paths of study in turn present themselves, each apparently of as much or even greater promise than the one just trodden over. The electric light has long ceased to be a curiosity or even a novelty. It has become a common every-day affair. To the scientist, to the electrician, it looms up even as a thing of the past. The question to which he now turns is: What shall we do next? The inventor, who finds his services no longer in such great demand in the field of electric lighting, also considers the same question. What shall it be? The answer is "The electric railway!" That, in our opinion, is the great achievement that will next come to the surface to proclaim the grand properties of the force at our command and the genius of those whose task is to deal with their utilization.

It is scarcely four years since the world first heard of the electric railway and talked of it as the latest wonder, the latest surprise of the day. Dr. C. W. Siemens (now Sir Charles) is entitled to the credit of first conceiving and carrying out the application of electrical energy to the propulsion of railway cars, by transmitting it from a stationary source. The first electric railway was laid by him in Berlin in 1879, more as a kind of public toy, or as an advertisement, than as a business enterprise; and yet this public experiment sufficed to demonstate fully the practicability of electric railways. This line was only 900 yards in length; the gauge of the road was two feet and the car could carry only about twenty persons. A Siemens dynamo-electric machine, actuated by a current conveyed along a central rail supported on wooden blocks, was placed on board the car and served to put it in motion. The rails of the road were utilized as return conductors for the current.

Since that time the interest which was awakened by this experiment has not diminished. In this country, Edison took up the subject almost at the same time and began a series of elaborate experiments on a grand scale. Other American inventors also turned their attention to the matter and studied it more or less intently. Among these men we may cite particularly Mr. Stephen D. Field, of this city, a celebrated electrician, who has become identified with the science by his ingenious application of the dynamo-electric machine to telegraphic circuits. It appears that this inventor turned his attention to the electric railway at an early date, and there is a good deal of evidence to maintain the claim of his priority in this respect.

It is in Europe, however, that the development of this application of electricity has received the greatest impulse. The American public considered itself too practical to enter into any such doubtful enterprise as an electric railway, and the successful experiments of Edison with his electric railway system in operation at Menlo Park do not appear to have evoked much interest, beyond that of mere curiosity. In Europe, on the other hand, the electric railway was at once accepted as a success, as was shown by the laying of a longer line for ordinary public traffic in Berlin, from Potsdam to Lichterfelde, a distance of three and a half miles. In this line both rails were placed upon insulating sleepers, so that the one served for the conveyance of the current from the power station to the moving car, and the other for completing the return circuit. This line had a gauge of 3 feet 3 inches, was 2,500 yards long, and was worked by two dynamo machines, developing an aggregate current of 9,000 watts, equal to about 12 horse-power. It has been in constant operation since May 16, 1881, and has never failed in accomplishing its daily traffic.

Then came the electric railway which conveyed passengers from the Place de la Concorde to the Palais de l'Industrie, in Paris, during the Electrical Exhibition of 1881. In this road the gauge was broader still, being four feet eight and a half inches, and a novel method of conveying the current to the dynamos was resorted to. In this case, two suspended conductors, in the form of hollow tubes with longitudinal slit, were adopted, the contact being made by metallic bolts drawn through these slit tubes, and connected with the dynamo machine of the moving car by copper wires passing through the roof. Within the short period of seven weeks about 95,000 passengers were conveyed on this line.

During the last year Siemens has contributed still more to the development of the electric railway by the line which he has recently completed in the north of Ireland. This line is of three-foot gauge and six miles long. The rails are joined electrically by staples at convenient points, and they both constitute the return conductor, the current being conveyed to a car through a T iron placed upon short standards and insulated by means of vulcanite caps. The power for this railway is at present produced by a steam engine driving a shunt-wound dynamo of 15,000 watts, or about 20 horse-power, but arrangements are now said to be in progress for the purpose of utilizing a water-fall of ample power by means of three turbines of 40 horse-power each. The working speed of this line was restricted to ten miles an hour, which was readily obtained, although the gradients of the line are decidedly unfavorable, including an incline of two miles in length having a grade of 1 in 38.

It has been said that none of these railways of Dr. Siemens have yet proved a financial success, except the one of the Paris Exposition, where it was possible to secure patronage, even though the rates charged where somewhat extravagant. Admitted that this is the case, we might suggest in reply that neither was the electric light a success at the beginning. There is some doubt about it even now. But it is bound to be a success! So with the electric railway. Sir. Charles Siemens evidently has full confidence himself in the financial success of the electric railway, for he has lately taken a contract for building a new railway, and the contract stipulates that the Messrs. Siemens shall operate the road at a stated price per annum, which surprises everybody by its moderation. This new electric railway is to be run under the Thames River in London. It will be about two-thirds of a mile in length, and will connect Charing Cross with Waterloo Station, hence the name of the company which is promoting the enterprise is Charing Cross & Waterloo Electric Railway Company.

The generating station will be on the Waterloo side, and the current will be conveyed to the dynamo on each car by a central rail. The tunnel will be large enough to afford a double track, and the rails will be laid on wooden sleepers imbedded in concrete. The cars (or carriages, as they call them in England) will be constructed somewhat after the pattern of the English tramway, which is the type of construction adopted so far in all the electric cars of Sir Charles Siemens, and will be made entirely of steel and wood, without any cloth or leather lining, as in those made for the tramways by Messrs. Stephenson, of New York. The wheels will be under the centre of the car, with a wheel-base of five feet. The floor of the cars will only be nine inches above the rails, the floors of the terminal platform being on the same level as the floor of the cars. The centre of the car being occupied by the dynamo machine, each end will be devoted to passengers, one compartment being for first and the other for second-class passengers, which will be distinguished by different colored lamps.

The cars will be run at the rate of eleven miles an hour, or will make the trip from the Grand Hotel at Charing Cross to the loop line at Waterloo in 3½ minutes. The tunnel is to be completed in eighteen months. The cost for the rolling stock and for laying the plant is to be £12,000 (about $60,000). The Messrs. Siemens are also to work the railway for £5,000 ($25,000) per annum and one-fifth the yearly gross receipts from traffic in excess of £20,000. The terms under which they agree to work the railway make the undertaking seem like a rash one for Messrs. Siemens, because it is estimated that four millions of people will cross the Thames on this railway. If the results show that the work can be done for that sum, then certainly the economy of the electric railway will have been thoroughly demonstrated. It is calculated that with a daily traffic of 4,000 passengers at two-pence (four cents), or 8,000 at one penny (two cents), the receipts per annum (£24,000) will be sufficient to pay a dividend of 18 per cent. on the capital.

According to the prospectus of the company, this railway is only the first of five which are to cross under the Thames at various points.

We believe that it is particularly in underground railways that electricity is above all specially applicable. In underground railways where the ventilation is already a matter of trouble, it is obviously out of the question to think of using steam as the agent of locomotion. The sulphurous, stifling smoke, the groaning, hissing steam, the annoying, reverberated puff, must be abated. Compressed air engines are the only available remedy outside of the electric locomotive, and of the two the latter is sure to receive the first consideration from its greater simplicity and convenience. The public interest will no doubt be centered upon this new undertaking and will watch its progress with attention.

At the same time that this project is under consideration in England, another electric railway is talked of on the continent, in Switzerland. The Swiss Parliament (Bundesrath) is now considering the expediency of granting franchises for the construction of an electric railway between St. Moritz and Pontresina, and which will be over seven kilometres long, with prospects of further extension, so as to connect Chiavenna and Coire. Furthermore, should this electric railway give good results, it is contemplated that another will be constructed for the Engadine. In this case, also, the electric railway will have a great advantage, for there is plenty of water power in the shape of water-falls in this district which can be utilized.

In concluding this review of electric railways, it is proper to mention the project of a French electrician, M. Chrétien, who proposes to introduce the electric railways under a new phase, namely, as elevated railways. M. Chrétien proposes to place his electric carriages on an elevated road, something like the New York Elevated Railroad, and in this way to relieve the streets and boulevards of Paris. The establishment of a line of this kind from the Madeleine to the Bastille is under contemplation. Experiments in the same direction have been in progress on the elevated railways in this city for several months. What the results have been have not yet been made public.

No doubt much remains to be done, in the way of invention and improvement, before the electric railway can

be a success, especially for longer distances. We do not foresee, like some enthusiasts, that the electric locomotive is to supplant the steam locomotive. The steam locomotive has special advantages of its own, which cannot be matched by the electric locomotive—in its present state of perfection, at least. We believe that it is destined to bear the same relation to the steam locomotive that the telephone does to the telegraph, or that the electric light does to gas. Nothwithstanding all fears of depreciation on the part of the latter, the former have only tended to aid the latter by becoming means of extension and development to them. It seems as if there were another phase of evolution at work here by which the growth on one branch of science is prevented from reacting of the progress in the others.

Postal Telephony.

It will be remembered that one of the great uses which was anticipated for the telephone was its employment as a medium of communication between cities. There has been but little done, however, to further this idea. In this country there is a sort of understanding or agreement between the telegraph and the telephone which must tend to restrict the use of the telephone between cities, leaving the telegraph a clear field. In Europe, however, where the telegraph is a government monopoly, and where the telephone is destined to be eventually also controlled in like manner, it is a matter of surprise that action has not been taken sooner in this direction. A Paris paper, the *Figaro*, stated, a few weeks ago, that M. Cochery, the Minister of Posts and Telegraphs, was contemplating the inauguration of a system of telephony between cities. The idea would seem to be to work the telephone in connection with the telegraph, so that the public could talk directly with the office or the station, or the individual desired himself, if the latter is connected with the telephone system in that place. The rate of charge mentioned is 25 centimes per five minutes, or less; or a person paying a yearly sum, which would be 175 francs in Paris and 200 francs in the provinces, might be permanently connected with the office and supplied with the apparatus for a year. This might be a means of economy to the subscriber in some cases; for, assuming that it is desired to communicate with a distant place where no telephonic communications exist, the subscriber could still send his message by telephone as far as it could go, and have it telegraphed from that point at the usual rate between there and its destination. Telegrams received could also be dispatched to the subscriber by telephone immediately, while the message could be forwarded by mail, as a ratification of the one transmitted by telephone. The date of beginning of this projected service has been fixed for the 1st of July, 1883. There is a system of this kind already in operation at Rheims, which has been opened as a experiment. According to some other Paris journals, the above given announcement is premature, as the question of extending this project will depend on the success of this experimental system. We will watch the developments of the project with interest.

Latest Development of the Telephone.

It appears that the experiments lately carried on over the Postal Telegraph Company's wire, to test the possibilities of the telephone in transmitting speech to long distances, are not the only ones which deserve mention in this connection, and that there are other systems besides those tried in the experiments between New York and Chicago that will likely come in for a share of the credit due to such an important and interesting achievement. A new company, the Globe Telephone Company of this city, has come to the front lately with apparatus of improved construction, and the results that have been attained with it are said to have been remarkable. The company has tried its experiments, at various times within the last three months, on a circuit between here and Philadelphia, the resistance of the line being considerably over that of the Postal Telegraph Company's wire between New York and Chicago. The line was one owned by the Bankers and Merchants' Telegraph Company, and it was included in their cable across the Hudson, together with twelve other wires, some of which were being used continually for quadruplex and ordinary Morse circuits. The results are said to have been satisfactory beyond anticipation. The articulation was quite free from the inductive disturbances which might have been expected from the passage of the wire through the cable. The company is well satisfied with its success, and it proposes to make its system known to the public in due time, when its arrangements are completed. By the courtesy of the management we have been permitted to examine the apparatus and to witness some experiments showing its extreme sensibility. The special merit of the system consists in superior delicacy of adjustment. One of the transmitters was adjusted so delicately that even the slight tremor of the Mills building, where the office of the company is located, was sufficient to cause a roaring, rushing noise at the receiver. It is claimed that this telephone will surpass all its rivals for loudness of articulation. Those interested will await complete details of this system with interest, and we hope to be able to gratify their desire soon.

Electricity and its Relation to the Senses.

Modern discoveries exhibit accumulating evidences of the intimate relations existing between the forces which we call heat, light, electricity and magnetism. These appear to be only various modes of motion convertible one into the other, and on this fact the doctrine of the correlation of forces is based. One of the most recent discoveries is the intimate relation between the transmission of light and electric induction. The similarity between light and sound was pointed out by Sir Isaac Newton, who compared the seven colors of the prismatic spectrum to the average tones of the diatonic scale. This comparison has been extended a step further by later investigators, whose researches have disclosed equally important relations existing between other forces in like manner. Their observations tell us of intimate relations between light and electricity, which are as interesting as those between sound and light. The elaborate experiments of Mr. Bell with his photophone, and those of M. Mercadier with his radiophone, are good instances of this extension in scope of the doctrine of the conservation of energy and of the correlation of forces. These are results that make one feel like anticipating grand and wonderful applications of electricity, in comparison to which even the present wonders of electricity would lose interest. Who can tell whether we are not already on the high road to one of these wonders—telephotoscopy—the vision of objects at a distance? To the physiologist, the sensations of sight, sound, smell and taste are but mere modifications of one fundamental action—sensibility. He looks upon nervous action very much as we look at force; he has his own peculiar doctrine of correlation which accounts, to his satisfaction, for the intimate connection between each of its phases and the others. No doubt the question will soon occur to him: If we can transmit sound and light, why not taste and smell, or touch? They are all but different modes of the same force. To those who take an interest in such anticipations we commend an article on "The Color of Sound," in another column, which is one of the clues to the questions.

Both Sides of the Question.

The easiest thing in the world is to adopt an opinion and believe in it thoroughly, if no arguments in opposition are presented. Newspapers are prone to this one-sided form of discussion, especially in cases where subjects treated are ones which they are not familiar with, and where there would be some trouble in reaching conclusions for and against. The following comments on the underground system which we find in an exchange are a fair illustration of ordinary newspaper discernment:

Telegraph poles cost about $1 each; the wire stretched on them costs about $15 a mile; the cross arms costs five cents a running foot; the insulators cost two and a half cents each by the hundred for light wires, and seven to eight cents for heavy wires. With these figures anybody can figure out the cost of putting up a telegraph line, adding the cost of labor. Of course it is much cheaper to string wires above ground, and that is the reason telegraph and telephone companies oppose the underground system.

This sounds quite like a forcible conclusion to any one who does not understand the matter. The simple truth is, however, that if economy is the aim, the underground advocates will win the day. It is easy enough to figure up the cost of constructing overhead lines, but the expense of keeping them in repair is a matter of considerable importance and expense which the profound reasoner quoted from seems to entirely ignore. Poles rot off; accidents from wind and storm are a constant source of damage; wires rust, become oxidized and break, involving the destruction of and interruptions to other lines. Careful investigation will prove to the disinterested that in the end underground lines are the least expensive. The question, however, is not wholly one of expense. It is the absence of an underground system whose practicability has been demonstrated that deters the companies from adopting this method of running their wires in cities. It is a pity that city councils, legislators, the editors of the "great dailies" and the public cannot be brought to see this matter in its proper light.

Earth Currents.

M. A. C. Hissing, inspector of the telegraphs in the Netherlands, has just published, under the pseudonym of Peter von Salgs, a pamphlet on earth currents proper, and on the means of diminishing the effect of the disturbances which they cause in telegraphic transmissions. Under the name of earth currents proper the author designates only those natural currents whose existence is observed in telegraph wires, and which result from a difference of potential between two points of the terrestrial surface. The author indicates different methods of distinguishing these currents from those which are produced by storm clouds or by chemical actions taking place in the soil.

The author professes with us that fecund theory due to the genius of the great founders of electrical science, and in virtue of which the sun is a wonderful magnet, which distributes magnetism and electricity in the same manner as heat and light. He deduces from this fertile idea the means of diminishing the spontaneous currents in a strong measure, and he proposes to place the ground plates *perpendicularly* to the magnetic meridian. Experiments made in the island of Sumatra, at the respectable distances of 215 and 221 kilometers seem to confirm this mode of reasoning.—*L'Electricite.*

[We cannot say that we are prepared to accept the theory that the sun is a magnet, even though we might readily believe that it is the primary cause of these earth currents. Until we get better and more thoroughly convincing evidence, it will be safer, in our opinion, to ascribe these pheneomena to some phase of the correlation of forces, or, if we please, of the conservation of energy.—ED. ELEC. W.]

French Academy Prizes.

The Boidin prize of the Académie des Sciences, which was to have been granted this year for the best thesis on the origin of atmospheric electricity and the causes of the great development of electrical phenomena in storm clouds, is to be opened anew to competition on the same subject. The commission decided that of the seven theses submitted none deserved the prize, because they only advanced theories as to the nature of the phenomena, without detailing any experimental inquiry into the subject. The commission, however, granted a prize of appreciation of 1,000 francs to the author of one of the theses, entitled "Contributions to the History of Storms." The competition will be extended until the first of June, 1885. The Boidin prize is a gold medal of the value of 3,000 francs.

The Fourneyran price of the Académie is opened to competition until the first of June of the present year. The question, which is one of great interest at the present time, in view of the attention it is receiving, is the theoretical and experimental study of the different methods of transmitting power at a distance.

It may be added that the grand prize of the section of mathematical sciences is open until June, 1884. It involves a similar question—to perfect in some important particular the theory of the application of electricity to the transmission of power.

Success of Our New Departure.

The division of THE OPERATOR AND ELECTRICAL WORLD into two distinct papers appears to have met with the most pronounced favor. From all directions we are receiving letters warmly approving the change and also inclosing the additional 50 cents necessary to entitle present readers of THE ELECTRICAL WORLD to a copy of THE OPERATOR each issue until the end of the present year. As stated last issue, the papers will be entirely independent of each other, and there will be sufficient matter to make both interesting and valuable to all classes of electrical readers. We hope such other readers of THE ELECTRICAL WORLD as have not remitted for THE OPERATOR will now do so, and try both papers at the above special rates. Where it is desired to have both subscriptions expire at the same time, and the present subscription runs either a longer or shorter time than to the end of the year, the amount remitted can be either more or less than 50 cents, as the time the present subscription runs is longer or shorter than to the end of the present year.

Patent Decision.

In an interference in the Patent Office between Starr and Peyton on the one hand and Moses G. Farmer on the other, in regard to certain improvements in electric lighting, the former made an appeal to the Secretary of the Interior, from the decision of the Commissioner of Patents, regarding the priority of invention. The Secretary of the Interior has lately rendered a decision affirming the action of the Commissioner. He holds that the applicant having sufficiently demonstrated, in the manner prescribed in the statute, by the specifications and drawings that he has completed the invention, and that it is capable of successful operation, he is not required to show further that he has actually reduced it to practice; that a failure to show in the drawings a conventional device for accomplishing a certain object is not fatal to a complete exposition of an invention where the specifications afford an adequate disclosure.

Some Cases in Point.

"The best proof of the pudding is in the eating" is a good old saying. The best evidence of the need of the facilities which we opened a week ago to the public, in the establishment of an Electrical Agency, is the fact that several persons have already availed themselves of its facilities. This immediate encouragement is a gratifying surprise, and a favorable indication that our efforts are appreciated. We shall endeavor to so conduct the business of the Agency that the confidence so early reposed in it may not be shaken. The many manifestations of interest in this new department give us great pleasure, and we are exceedingly grateful for the same, especially since we owe it to readers of THE ELECTRICAL WORLD.

The Color of Sound.

The subject of *seeing* at a distance by electricity, or transmitting light over the wire, has already received some attention from our scientists, and to those who are interested in the subject the following article, clipped from the *Medical News*, may prove very interesting: A curious and but little known fact is that with certain individuals the hearing of sound is always accompanied by sensations of color. The first published observations upon this subject seem to have been made by Nussbaumer. Both this writer and his brother habitually experienced such double sensations, and even found that with each note of the musical scale a special color always appeared. Bleuler and Lehman afterward confirmed these observations, and reported that they had examined five hundred and ninety-six individuals who had this peculiarity. These cases all occurred in Germany. In the November number of the *Annales d'Oculistique*, Pedrono reports in detail a case of this kind. The individual who is the subject of these double sensations discovered quite accidentally that his position was peculiar. He had always been conscious that sound, especially that of the human voice, invariably awakened a sense of color, and that the same voice always called up the same color. On one occasion, however, a person speaking to him of a friend said: "Have you remarked his voice? It is as pretty as a yellow dog." Pedrono's patient replied very seriously, "Not at all, his voice is red, not yellow." Whereupon the bystanders roared with laughter.

Pedrono found in this case that each note of the musical scale produced a sensation of color, but, although his subject was an excellent musician, he was not able to define a special color for each note. High notes were accompanied by brilliant, low by sombre colors. But if two consecutive notes of the scale were compared, the colors appeared nearly identical. In a perfect chord a single color was produced. For instance, the chord in F major produced yellow, while that in A minor produced violet. But in an imperfect chord some of the notes detached themselves with their proper colors, although very near the general hue.

There was no appreciable difference between the colors corresponding to major and minor tones, between scales in sharps and flats. The same piece of music played upon different instruments produced different colors, showing the effect of timbre. For instance, the Bretonne melody, "Appel des Patres," played on a tenor saxophone was yellow, on a clarionet red, on the piano blue. Intensity of sound produced distinctness of color. With feeble sounds the color seemed to show vibrating movements.

Noises of all sorts provoked chromatic sensations, but the colors were always sombre, generally gray or brown. When the voice was used in a conversational tone the vowel sounds only were colored, i and e being the most brilliant, u the most sombre and a and o intermediate. The general hue depended upon the timbre of the voice. If the voice was very strongly emitted the consonants became barely perceptible, the sibilants being brightest. Singing simply intensified these results, each voice retaining its characteristic color. Blue voices were much the most numerous; green the most rare; yellow the most agreeable; red voices were not unfrequent. Of course different voices represented all shades of these colors.

As to the localization of the colors, all observers seem to agree that they are projected mentally to a point just above the supposed position of the instrument which is sounding or the person who is speaking, and without reference to whether the object is seen or not. A vibrating guitar spring appears to be surrounded with color, and a layer of chromatic-air rests upon the keys of a sounding piano.

If anything additional to the phenomena of monocular color blindness were needed to demonstrate the existence of cerebral centres for the perception of colors, independently of all other ocular sensations, the facts adduced, in connection with the phenomena of colored hearing, would seem to be sufficient.

A Model Establishment.

ILLUSTRATING THE VALUE OF THE TELEPHONE.

It is interesting to wonder what the circumlocution office—if it can be possible that there is such a bureau anywhere under any Government—would think of Colonel Dudley's telephone. Colonel Dudley is the Commissioner of Pensions—a brisk, energetic man at the head of probably the busiest bureau in the Government. He has a soldier's impatience with slow processes, and no fondness for following red tape through all its convolutions. So there runs over his desk an ugly metal elbow, and on the end, within easy distance, is the telephone. The Commissioner is on the second floor of the building. That floor is full of clerks, and there are four floors more of clerks above him. Two blocks away on the avenue is a large building also full of clerks, and there are others—nearly 1,600 in all. The telephone commands the entire army. The Commissioner wants to give a direction. He signals the operator: "Give me Smith." Smith is probably on the third floor of the building two blocks away, but he has a telephone on his desk also, and he answers almost as quickly as if he were talking to the Commissioner across the table. The direction is given in an instant, and the Commissioner turns to the next matter. Space has been annihilated and red tape is nowhere. A Congressman asks for information of the status of the claim of the needy mother of a boy who was shot dead at Atlanta. "Give me Gibbs," remarks the Commissioner to the telephone. Gibbs is promptly bestowed upon him. "Tell me the status of claim 2,000,001, Mary S. Brown, mother of Paul Brown, Twentieth New York Volunteers." Gibbs wants to know if any "additional" evidence has been filed—that is evidence supplying points which were wanting in the evidence first submitted. There has been, but when, the Congressman does not know. "Give me Peters," says the Commissioner, turning away, and in a moment Peters is busy looking up the record. A moment's talk, the bell sounds, the Commissioner listens, and then tells the Congressman that the case needs better evidence of the mother's dependence on the son, and cannot be passed until that is furnished. And so on. The whole cost of the telephone service is $600 a year, less than is paid to one messenger, but doing the work of many. The amount of business transacted by this bureau is enormous. Its monthly mail is as large as that of a city of 20,000 inhabitants. During March there were received about 150,000 pieces of mail matter, and there were sent over 130,000—not all the communications requiring acknowledgment.—*Washington Correspondent, N. Y. Tribune.*

Flirting by Telephone.

As an aid to flirtation the telephone has a decided advantage over the telegraph, in that it allows the charms of the voice to be brought into play. That the amusement may be a dangerous one, however, is shown by the Boston *Globe*, which says that among the employés at the central office in that city is a boy whose voice has not yet taken on the bass tones of manhood, but is still of a pure soprano quality. He substituted for a young lady operator one day, and in the course of his duties was seen to smile very broadly. His nearest neighbor, a young lady, seeking to find the cause of his amusement, was told that a bank clerk up town was trying to flirt with him. No sooner said than the lady connected this particular bank clerk with all the operators in the room, and all of them took in the conversation, including the answers dictated to the boy by his lady friends. The up-town masher exulted in his easy conquest, and appointed a meeting, saying that when the central office closed he would station himself in a certain doorway, and that the fair damsel might know that he was the proper party by the nosegay he would wear in his buttonhole. At the appointed time about a dozen of the girls proceeded to walk leisurely up street, in groups of three and four. In the stated doorway stood the hero, faultlessly arrayed, with kid gloves and cane, and the æsthetic bouquet. As the first group approached he ran his eye pleasantly over their faces in search of some token of recognition. But they passed him by, laughing in their sleeves. The same treatment was given by the next group, who could scarcely restrain their laughter at the excitement of the elegant young man. As the last group approached his excitement got the better of him, and he stepped lightly forward, bowing and smirking, and said in his most captivating way, "Which one is it? which one is it?" The girls mastered the situation sufficiently to repress the faintest shadow of a smile, and coldly stared at him without a word and passed on. When that young man attempts to flirt again he will be likely to choose some other than a telephone operator.

Electric Service in Every Day Life.

There is probably no other building, except perhaps the Grand Opera-House in Paris, in which the possibilities of electric service in every day life are shown so completely as in the National Museum at Washington. The building covers a large area, and easy and rapid communications between those who work in it is a matter of importance. First should be mentioned a system of telephones and call-bells, by which those in any room communicate with every other room. Twenty-six telephones in the building are connected by a telephone exchange in a room near the main entrance, and this local exchange is connected with the main telephone office of the city, so that each employé can talk with every other employé and also with every telephone subscriber in the city Owing to this telephone service only three messengers are used. Electricity supplies the light which is used in the photographic laboratory, so that the work does not depend upon a fickle sun. If one of the 850 windows or one of the 230 doors is opened, a bell rings and an electric annunciator shows to the attendant in the main office just which window or door has been touched. This system is to be extended to each of the many cases in which specimens are exhibited, so that the attendant in the main office will know when one of these is disturbed. The watchmen on duty in the night are governed by electricity. There are stations which each watchman must visit every hour, and he must by a slight motion release an electric current which pierces a paper dial and records the hour and minute of his visit. The time of day is shown by the action of an electric current upon the hour and minute hands of sixteen clock-dials distributed through the building. The parts of the museum open to the public are illuminated by electric light. The currents used in the building are conveyed by 65,000 feet of wires.—*New York Times.*

Electrical Resistance of Copper Wire.

In answer to frequent inquiries as to the electrical resistance of copper wires of different diameters and lengths *La Nature* says that a pure copper wire 1 m. long and 1 mm. in diameter has a resistance of 0.02 ohm at 0° C. If, now, we have a wire of a length l (in meters) and a diameter d (in millimeters), its resistance r at the same temperature is represented by the formula:

$$r = \frac{0.02 \times l}{d^2} \text{ ohms.}$$

Applying this to a wire having a length of 25 m. and a diameter of 0.4 mm. we have:

$$r = \frac{0.02 \times 25}{0.4^2} = 3.125 \text{ ohms.}$$

Pure copper, however, is difficult to obtain in commerce, the best quality, for dynamo machines, etc., having a conductivity of from 93 to 98 per cent. The conductivity of ordinary copper wire varies between 70 and 90 per cent., often, in fact, falling as low as 50 per cent. and less. It is therefore not at all surprising to find an ordinary copper wire of the above dimensions having a resistance of, say 6, 7 and even 8 ohms in place of 3.125 ohms, corresponding to a temperature of 0°C. Increase of temperature increases the resistance of pure copper by about 38 per cent. for every degree C. Thus, for example, a wire having a resistance of 3.125 ohms at 0° C. will, at a temperature of 15° C., have a resistance:

$$r = 3.125 + \frac{3.125\,(0.38 \times 15)}{100} = 3.303 \text{ ohms.}$$

If, in place of knowing the diameter of the wire, we have its section in square millimeters s and its length in meters l, then the resistance r is found from the formula:

$$r = \frac{0.0162 \times l}{s} \text{ ohms.}$$

In using this formula, however, it should be remembered that the wire is assumed to consist of pure copper and to be at a temperature of 0° C.

Enlightening a Colored Man.

An Evansville, Ind., paper publishes the following interview between Mr. C. J. Murphy, of the Brush Electric Light Company in that city, and a colored gentleman of an inquiring turn of mind, which will interest readers of THE ELECTRICAL WORLD:

A colored gentleman, who from his domesticated appearance might be regarded as a member in good standing in the Lime Kiln Club, walked timidly into the electric light station a few evenings since, and after his surroundings had been courteously taken in, timidly ventured to ask:

"Boss, would you please, sah, tell me what makes dat light?"

"Yes, uncle; that light is produced by electricity."

"What is dat, boss?"

"What? Electricity you mean?"

"Yes, sah."

"Electricity, according to the modern theory of the conservation and co-relation of forces, is a mode of motion of the molecules of matter."

"Yes, sah."

The old gentleman seemed paralyzed with amazement, and assuming a still humbler attitude, asked:

"Boss, what makes dat light git brighter sometimes?"

"The gravitation of the upper carbon, retarded by magnetic influence."

"Dat's what I thought made it do dat way; now, how does you squirt de kerosene through de wires?

"That is not kerosene; it is the manifestation of friction that is offered by the resistance of an imperfect conductor to a highly excited electric condition of the metal in the apparatus, caused by the molecular disturbance induced by motion and magnetism."

The old gentleman wore a broken-up expression, and after collecting his scattered thoughts he wiped the perspiration off the end of his nose, and, completely subdued, asked if he could have a drink of water. After refreshing himself and thanking his informant, he was heard to remark in passing out:

"Dey hain't none of dese niggahs knows how de white folks makes dat light but me. Hey! Hey! Yow!"

Electrical Time Service in Ohio.

The Time Telegraph Company of Ohio, a branch of the Time Telegraph Company of New York, was incorporated on April 26. The company has elected directors and placed all but $240,000 of its $600,000 of stock—Cleveland reserving the $240,000 as treasury stock. It will furnish a clock regulated by the sun, needing no attention or winding, and ornamental in appearance, to whomsoever will pay $3 per annum in advance for the same, $6 if they want in addition a sweeping "second-hand," and $12 if a sweeping second-hand and a calendar of the days of the year is required, the more expensive clocks being, of course, large and handsome. The plan involves a central office, with operators always on duty. The company hopes to make its money by the volume of its business, and to this end will establish stations along the lines of all the railways, giving them the exact railway time from the terminal station, and furnishing the clocks to the towns adjacent, even if of only five hundreds inhabitants. The cities of Cincinnati, Cleveland, Toledo and Columbus will be operated direct by the mother company, and the rights for smaller cities will be sold. The stock of similar companies (under the New York Company, which has bought up all the rights of electric clock patents it could find in the world anywhere, and which claims the control of the synchronizing system in every country) in Pittsburgh and elsewhere has been eagerly taken up, and the enthusiastic friends of the movement claim its assured success. The headquarters of the Ohio company are in Cleveland.

Franklin's Lightning Rod Advertisement.

The "Poor Richard Almanac" for 1753, printed by Benjamin Franklin, contains the following advertisement relative to the then recently-invented lightning-rod:

HOW TO SECURE HOUSES, ETC., FROM LIGHTNING.

It has pleased God in his Goodness to Mankind, at length to discover to them the Means of securing their Habitations and other Buildings from Mischief by Thunder and Lightning. The Method is this: Provide a small Iron Rod (it may be made of the Rod-iron used by the Nailers), but of such a length, that one End being three or four Feet in the moist Ground, the other may be six or eight Feet above the highest part of the Building. To the upper End of the Rod fasten about a foot of Brass Wire, the size of a common Knitting-needle, Sharpened to a fine Point; the Rod may be secured to the House by a few small Staples. If the House or Barn be long, there may be a rod and Point at each end, and a middling Wire along the Ridge from one to the other. A House thus furnished will not be damaged by Lightning, it being attracted by the Points, and passing thro' the Metal into the Ground without hurting any Thing. Vessels also having a sharp pointed Rod fix'd on the top of their Masts, with a Wire from the Foot of the Rod reaching down, round one of the Shrouds, to the Water, will not be hurt by Lightning.

Schools of Electrical Engineering.

It is said that Mr. Edison has offered to Columbia College the collection of electrical instruments exhibited at Paris last year on condition that the college shall establish a school of electrical engineering. The offer is now under consideration, but it is thought that the cost of maintaining such a school will be considerable, and the trustees consequently refrain from making any definite promises. Meanwhile, it appears, Mr. Edison has resolved to begin the systematic instruction of electrical engineers in a school to be established in this city. The extent of the business of the Edison Company is so great that competent men cannot be obtained to take charge of the work, and a practical training school under such auspices will therefore, without doubt, be successful and valuable. As a matter of general interest we would state that electrical engineering departments have already been established by different institutions in the country, as, for example, the Massachusetts Institute of Technology, which will soon be ready to graduate its first class, Cornell University, and the Stevens Institute of Technology, Hoboken. The department in question at the latter institution is of comparatively recent origin, and it yet remains to be seen whether it will be productive of beneficial results.

Increase in Electrical Patents.

From a recent address by Mr. E. M. Bentley, one of the examiners in the electricity division of the Patent Office, it appears that about two thousand applications for patents in electricity were filled in that office in 1882, of which about two-thirds were granted. To show how the subject had grown in importance within a very few years, Mr. Bentley said that in 1877 electricity was a sub-class in a division. Now it is the largest division in the office, and regarded as the most important. This astonishing growth is due chiefly to two causes—first, the invention of the telephone; and, secondly, the development of the magneto-electric machine. The telephone has opened, directly and indirectly, a wide field of invention. The minds of many persons are now turned to this class of inventions, and not only are improvements on the telephone itself attempted, but attention is given to a great many incidental appliances useful in its successful application. The development of the magneto-electric machine offers an equally large field for improvements.

A Woman who Made Fortunes for Two.

A Washington corespondent says: "Mr. Bell, the telephone man, is worth $6,000,000, and he has the most elegant residence in Washington. A man told me to day that his wife is very beautiful, and that she is deaf and dumb. Bell became infatuated with her beauty and married her. In experimenting on an audiphone, that she might be able to hear, he discovered the principle of the telephone. In this way his wife indirectly made his fortune. Her husband's fortune is not the only one Mrs. Bell has made. Andrews, the portrait painter of Washington, owes his start to his picture of her face. Before this he had been unknown. He came here from Cincinnati, and had but little to do. Mrs. Bell gave him a sitting, and he had the luck to catch one of her most beautiful expressions. The picture was shown at Corcoran's gallery and crowds came to see it. After this the unknown artist was unknown no longer. Orders poured in, and he has now made enough to build him a fine house, and he is the portrait painter of the capital.

THE CHICAGO TROUBLE.—The mayor of Chicago says that the present ordinance which provides that all telegraph wires shall be laid underground after May 1 does not authorize the Western Union Company to lay underground cables, and that it has been so decided by Corporation Counsel Adams. The city has therefore no right to order the wires cut. An ordinance can, of course, be passed granting the privilege to lay underground cables, but a sufficient length of time would have to be given the company in order to allow it to complete the work.

THE TELEGRAPH.

AN ITEM OF HISTORY.—The first telegraph instrument was successfully operated by S. F. B. Morse, the inventor, in 1835, though its utility was not demonstrated to the world until 1842.

ENDING THE LITIGATION.—Judge Freedman, in Superior Court Chambers, on the 27th ult., dissolved the temporary injunction obtained by Josiah C. Reiff restraining the Western Union and Mutual Union Telegraph companies from carrying out the agreement between them for the lease to the former of the lines and other property of the latter.

THE BOARD OF TRADE TELEGRAPH COMPANY.—The Board of Trade Telegraph Company opened for business yesterday on 'Change and was flooded with messages. The line is operated over but three wires between St. Louis, Peoria and Chicago, and will only accept commercial business until the duplex instruments arrive and additional wires are strung. An attempt was made on Tuesday night to cut the cable wire at Venice, but the malicious design was frustrated by the vigilance of the sentry. About midnight the watchman observed a stranger approach and open the box containing the wires, and instantly hailed him. The man started off on a run and was joined by another at the bank of an adjacent slough. The guard opened fire and the two men took to the water and swam to the opposite bank. Regaining the land they turned and fled in the direction of Venice.—*St. Louis Globe-Democrat, April* 26.

THE ILLINOIS TELEGRAPH BILL.—In the Senate of Illinois, on April 24, Mr. Merritt's bill for an act to restrict telegraph monopoly was amended, and ordered to a third reading. As amended the bill reads as follows: If any telegraph company, incorporated or doing business in this State, shall exclude, or attempt to exclude, any other like company from constructing its lines and establishing its offices, or doing business in or at any particular place or premises not already necessarily and wholly occupied for such purposes, or prevent such company from connecting with the wires of other companies, or interchanging business with them, by virtue of any contract or agreement with the owner of such place or premises, or the company with which such connections or interchanges of business are desired, the company so offending shall for the first offense be fined not less than $1,000, nor more than $5,000; for the second offense not less than $5,000, nor more than $10,000, and for the third offense not less than $10,000, and not more than $20,000, and for each subsequent offense $25,000. This bill is intended to remedy troubles similar to those encountered at East St. Louis by an Eastern telegraph company.

THE TELEPHONE.

ASHTABULA, O.—Mr. Frank Talcott, ex-telephone exchange manager, is perfecting a patent to prevent induction on telegraph lines.

PITTSBURGH, PA.—The telephone company has received five miles of lead cables from the Western Electric Company, for underground work.

IOWA.—A telephone line is talked of between Egan and Flandreau. Sioux Falls has ninety-six telephones.

Over 525 telephones are in use in Des Moines.

THE INVENTION OF THE TELEPHONE.—In a lecture the other evening Bob Burdette said: "Speaking of the telephone, 100 years ago it would have been thought an invention of the devil—and I sometimes think it is now."

A LINEMAN FATALLY INJURED.—At Hamilton, Ont., on April 27, a young man named Thomas Evans, a repairer for the Bell Telephone Company, fell from a pole, while at work, to the stone pavement below, a distance of thirty-five feet. He was taken up unconscious and terribly injured, and will die.

ILLINOIS.—Telephone communication has been established between Carrollton and Berdan. The line and instruments work admirably. Other lines from Carrollton, connecting the prominent towns of the county with the Carrollton telephone exchange, are under consideration, and are among the probabilities.

Telephone wires now connect Mt. Sterling, Clayton, Camp Point and Quincy.

EAST SAGINAW, MICH.—This is the third city in the State in population, and second to Detroit in business and telegraphic communication. Eight operators are employed in the telephone exchange. Mr. James Green is day manager and Mr. C. E. Brown night manager, Miss Ida Forbes chief day operator. Mr. Green is also manager of the exchange at Saginaw City, and has recently established another exchange at Midland, thirty miles from East Saginaw.

THE TROPICAL AMERICAN TELEPHONE COMPANY.—The executive offices of this company are now in Boston. Mr. H. S. Russell is president of the company, Mr. J. H. Howard vice-president, and Mr. Charles W. Jones secretary and treasurer. The company has exchanges in operation at Barbadoes and in other of the West India Islands. The company also supplies telephones to nine other different telephone companies now organized and doing business.

WASHINGTON, D. C.—The National Capital Telephone Company has abandoned the system of charging for the number of times an instrument is used, and will hereafter place a fixed rental upon the use of telephones. For telephones to business houses on private wires $100 per annum will be charged, and for similar wires to private houses $65. The rate for business houses on the general circuit will be $60, and at private houses on the general circuit $48.

TEXAS.—The Laredo *Times*, announcing the arrival in that city of Mr. J. J. Ghegan, general manager of the Compañia Telegráfica-Telefónica Mexicana del Norte, with headquarters at Saltillo, says that Mr. Ghegan established telephone communication, by means of the Mexican government wires, between New Laredo and Monterey, a distance of 225 miles the route the wires run, and a very satisfactory experiment was made in its use, notwithstanding the long distance and impromptu arrangements.

VAN WERT, O.—The Midland Telephone Company has completed arrangements for the opening of an exchange in Van Wert. The supplies have arrived, and work will be commenced immediately. The list of subscribers numbers over seventy-five. The County Commissioners have refused to subscribe to the exchange or allow instruments to be placed in the Court-house, much to the disgust of the county officers and the citizens having business with them.

A NEW COMPANY IN PENNSYLVANIA.—The State Department at Harrisburg, Pa., has granted a charter to the Delaware and Atlantic Telegraph and Telephone Company in the counties of Chester, Bucks, Montgomery and Delaware, with a capital of $10,000. The general route and points to be connected are as follows: Philadelphia to Chester, Media and State line via Darby, Philadelphia to Coatesville, and thence to Lancaster County, with lateral lines to West Chester, Norristown, Phœnixville, and other points.

TWO YEARS' PROGRESS.—The telephone exchange in Huntington, Pa., has just celebrated its second anniversary. It began with thirty-five subscribers and now has one hundred. The towns it connects are Petersburgh, Alexandria and Barre to the west, and Mill Creek, Mapleton and Mt. Union to the east. Altoona, Philipsburg, Clearfield and Bellefonte exchanges have been connected by territorial lines during the past year, and the Lewistown exchange, which is to be put in operation soon, will then be in communication with these exchanges.

TEMPORARY DELUSION.—Mr. Thomas S. Gage, secretary of the Metropolitan T. & T. Company, of this city, was discovered to be suffering from aberration of mind last week, and was removed to the Tombs. His delusion is that he has discovered some of the secrets of the masonic order, and in consequence is being pursued by men bent on doing him personal violence. The prison physician pronounced him insane, and he was at once removed to Bellevue Hospital. His friends believe his delusion will prove but temporary, and assign overwork as its cause.

THE INTER-CONTINENTAL TELEPHONE COMPANY.—This company, organized under the laws of the State of New Jersey, has been formed by the consolidation of the Colombia and Venezuela Telephone Company and the Central American T. & T. Company. The company purchases its instruments outright from the the Tropical American Telephone Company at a nominal price. An exchange has already been established at Caracas, and others will soon be opened at some of the other principal cities in Venezuela. The officers of the company are Mr. Henry S. Russell, president; Mr. Chas. Williams, Jr., vice-president; and Mr. Jas. H. Howard, secretary and treasurer.

THE TELEPHONE IN PROVIDENCE.—A copy of the directory of subscribers of the Providence, R. I., Telephone Company has just been sent to us by the courtesy of Mr. J. W. Duxbury, superintendent of the company. It is a handy little manual, neatly arranged, so as to be easy of reference. It contains some 2,600 names, a fact which proves that the telephone is a success in that section, and that the book must be of considerable utility. It is prefaced with some very pertinent directions and details of information for the convenience of the patrons of the company. A circular containing the rules and regulations of the operating department of the exchange, which we received at the same time, contains many sensible ideas of discipline, which reflect great credit upon the management, and ought to do much toward rendering this department very effective. Other managers of other exchanges might do well to promulgate similar rules among their employés.

PORTLAND'S NEW EXCHANGE.—The transfer of the exchange in Portland, Me., from the old to the new quarters just fitted up was successfully accomplished on Monday evening last. The local papers say that everything had been so admirably pre-arranged that in less than three minutes after the bell had given the signal to the operators to leave the old telephone switch and operating room, they had taken their proper places in the new and handsomely fitted up exchange, and the electric current was diverted from the 400 old wires running to the old switch, to as many new points in the new. The new switch-board consists of twelve sections of from twenty-five to forty wires each. These sections are numbered, instead of being designated by letters, as already mentioned on page 200 of our March 31st issue, all connections or a given section are now made by one operator, instead of four as formerly. The number of annunciators in the exchange is 450, and the number of subscribers 800, with 25 more waiting for instruments.

THE TELEPHONE IN NORWAY.—The constantly increasing popularity of the telephone is well shown by recent statistics giving the number of these instruments in different cities of Norway. It appears from these that telephones were introduced into that country some two years ago, since which time there has been a rapidly increasing demand for them. So far as the number of instruments in use is concerned, it appears that the city of Christiana has a central station of the International Bell Telephone Co., embracing 700 subscribers. The city of Drammen has a central station, with some hundred subscribers, while stations are also located in Trondhjem, Bergen, Stavenger and Arendal. Even the smaller cities are now making active preparations to introduce the telephone, as, for example, Prosgruned, which has only about 3,000 inhabitants. In addition to these different lines, there are, moreover, an appreciable number of private telephone lines, the largest of which is one between the three cities of Prosgruned, Drevig and Langesund, the length being somewhat over two miles, and which connects the main office of one of the steamship companies with its several branch offices.

THE ELECTRIC LIGHT.

IN THE FAR NORTHWEST.—M. T. Billings is negotiating for the establishment in that city of an electric light plant.

RATES IN CANADA.—The Phœnix Electrical Co., of Montreal, offers to contract for the renting of the arc lights, at the rate of 60 cents per lamp per night.

LIGHT WANTED.—The mayor of Ottawa, Kansas, in his message calls the public attention to the following needed improvements: A court-house, gas or electric lights, sewers and water-works.

THE MAXIM COMPANY IN PHILADELPHIA.—The Girard Trust, of Philadelphia, tried to prevent the Maxim Electric Lighting and Power Company from erecting poles on Delaware avenue, but the court has sustained the company.

NATURE'S ELECTRIC LIGHT.—In Sweden, during a recent display of aurora borealis, the extent, vividness and mag-

nitude of which, it is reported, have not been equaled in that country for years, the big clouds which from time to time passed below the aurora did not affect in the slightest degree the phenomena.

ELECTRIC LIGHT IN BROOKLYN.—The Fuller Electrical Company and the United States Illuminating Company have petitioned to the Brooklyn authorities for permission to establish electric lighting circuits in various parts of the city. There was a hearing last week before the Aldermanic Committee on opening streets, and a decision will be made this week.

REMOVAL.—The United States Electric Lighting Company of this city has removed to its new building, Nos. 59 to 61 Liberty street. The office of the parent company is in room 1, main floor. The office of the U. S. Illuminating Co., the local company, is in room 21, second floor. Mr. L. E. Curtis, Secretary of the parent company, is in rooms 31 and 32, third floor.

THE ZANESVILLE (OHIO) ELECTRIC LIGHT COMPANY.—This company, briefly mentioned last week, has been incorporated, with a capital stock of $50,000. The incorporators are thirteen of the leading business men of the city. The Brush and Weston companies sent agents to Zanesville last week, and a representative of the Edison company was also expected. A committee of five has been appointed to examine into the merits of the lights made by each company. Mr. Curtis, of the Brush Company has invited the committee to go to Cleveland and examine the Brush system, agreeing to pay their expenses. The committee has accepted the invitation.

THE EDISON LIGHT IN ST. LOUIS.—Mr. Wm. T. Brewster, special agent for the organization of local branches of the Edison Electric Light Company, of New York, was in St. Louis last week, making arrangements to illuminate the central part of the city. It is reported that a company has been formed, and that agents are canvassing the district and making estimates, in order to arrive at the proper size of conductor which is to be laid under the streets. This sudden movement was undertaken in order to prevent prospective customers from entering into five-year contracts with the agents of the water-gas company. Mr. Brewster says that the company, being now assured of the financial success of the New York district, is taking steps to introduce a central system of lighting in over twenty towns and cities in the United States.

THE BRUSH LIGHT IN EVANSVILLE, IND.—The Brush Electric Light & Power Co. here boasts of having one of the most complete lighting stations in the West. The energy is supplied to six Brush dynamos (three 40 lighters and three with a combined capacity of 32 lights) by two 186 h. p. Cummer engines. The building was designed for this special purpose and is substantially and conveniently put up. We have been furnishing private consumers with the arc light for the past eight months, and expect soon to be ready, according to contract, to start fourteen 2,000 c. p. lamps suspended on 50-ft. arches on as many street crossings for the centre of the city, and ten towers of the Elgin type, 150 ft. high, with four 4,000 c. p. lamps on each, for the distribution of light for the remainder of the city. The gas company here deserves mention, inasmuch as it made a grand effort to retard the advance of the modern illuminant, though without avail. The question became a prominent one in our local politics, on account of the citizens' desire to be heard directly in this matter. THE ELECTRICAL WORLD, in the opinion of your correspondent, has been fortunate in securing those articles on electric lighting by C. O. M., as in them the subject is extremely well handled and is presented in as lucid a manner as it would be possible to present it. C. J. M.

MISCELLANEOUS NOTES.

ELECTRICITY ON CITY RAILWAYS.—Montreal is contemplating electricity as a motive power for the city passenger railways. The new president of the company is determined, if possible, to dispense with horses.

COOKING BY ELECTRICITY.—The New York *Commercial Advertiser* says that a machine for cooking by electricity is the latest product of Canadian genius. It adds that the new invention is scarcely equal to dynamite as a sudden explosive, but it tears a beefsteak to fragments in less time than it takes to pound it.

SUIT FOR LIBEL.—The Portable Electric Light Company of Boston has instituted proceedings against the Boston *Journal*, on the ground of an alleged false and malicious libel concerning the business and dealings of the Portable Electric Light Company. The damages are laid at $25,000, and the defendant's property was last week attached for the sum by E. B. Goodsell, counsel for the company.

A MYSTERY.—Mr. John H. Foley, an electrician, whose parents reside in Hartford, Ct., was supposed to have been lost in the Milwaukee fire; but a few days ago his bank account with George P. Bassett & Co., of Hartford, was found to have been drawn by a New York draft two or three days after the fire. His relatives, however, have not heard from him, and at their request the bankers have sent for the original draft, to ascertain whether the money was drawn on a forged signature.

THE BELL-CORD TO BE DISPLACED.—Conductor Judkins on the night train from Bangor, on the Maine Central Railroad, has devised a system of electric communication from each car to the engineer, which is intended to displace the familiar bell-cord. The system is the same as is used in hotels, excepting the method of connecting the wires between the cars, and for this Mr. Judkins will endeavor to secure a patent. The system has been successfuly employed upon Mr Judkins's train for some weeks.

ELECTRICITY FOR HORSES.—It is thought that a new cure has been discovered for balking and cribbing horses by the application of electricity. A gentleman of Baltimore, who has a horse subject to balking, placed an electric battery, with an induction coil, in his buggy and ran the wires to the horse's bit and crupper, and as soon as the horse came to a standstill the current was turned on, and after the horse was relieved of this shock, it is said, he proceeded without showing any disposition to balk. The same application was successfully made to a horse who indulged in cribbing, whereof he was soon cured through the unpleasantness of the electric shock. Those who have balking or cribbing horses may give the foregoing a trial.

THE CHICAGO RAILWAY EXPOSITION.—The construction of the electric railway at the Exposition building has begun, and a considerable force of mechanics is pushing it rapidly forward. The dynamos which are to furnish the electricity have been shipped and will soon be placed. It will not be many days before the experts in charge can make experimental tests of its efficiency. This will be the first electric railway ever operated in this country, regularly carrying passengers. There will be two trains of light and attractive cars, one of which will be making the circuit of the track, about one-third of a mile, while the other will be discharging and receiving its load of passengers. A pretty little station will be built in the northwestern portion of the gallery, with sufficient open space around it to accommodate spectators. The gallery is being strengthened with heavy timbers, and precautions will be taken to guard against accident.

STOCK QUOTATIONS.—Telegraph, telephone and electric light stocks were quoted on Wednesday of last week and Wednesday of this week as follows:

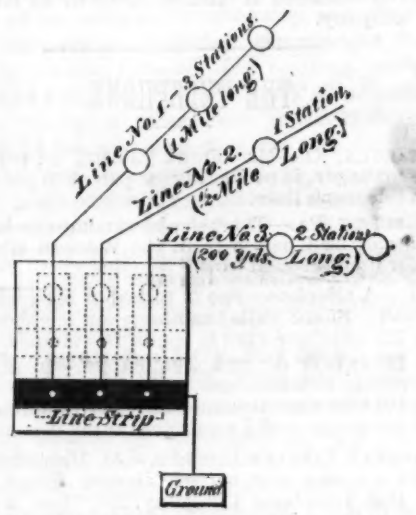
	April 25.	May 2.
Western Union Telegraph	82¼	82¾
Mutual Union Telegraph	20⅛	20¾
American Cable	66⅜	66¾
American District Telegraph	33	30
Edison Illuminating Co	58	50
Edison Electric Light Co	....	315
Parker Electric Manufacturing Co	....	215
N. J. & Long Island Telephone Co	....	96
Overland Telephone	....	30
Underground Electric Cable	....	50
U. S. Electric Light	128	50
Shaw Telephone	40	39
Mexican Telephone	3⅝	3⅜
Tropical Telephone	2⅛	2⅛
American Bell Telephone	225	221
Northern Telephone	....	....

DEPARTMENT OF INQUIRIES.

TELEPHONE SWITCHBOARDS AND INSUFFICIENT GROUND CONNECTIONS.

The following (perhaps not unusual) experience with a small three-line switchboard may be of interest to your readers, and if any of them can solve the matter we should be pleased to hear from them.

A ring on any of these lines outside of the switchboard *rings all the bells*; not strongly, but lightly. Conversation can be carried



on perfectly between any of the stations on the lines without connecting them together by plugging at the switchboard. The board has been once returned to the manufacturers and *pronounced perfect*.

The only question now is, Have we got a good ground or ground strip on our line? Let us see. The line strip is connected by No. 14 copper wire with a two-inch water pipe in the same building, *and soldered*. This pipe runs underground for three miles and a half, and is constantly full of water. But it did not work; so, in addition, we connected the same wire on two two-inch iron rods ten feet long, and drove it into a well one hundred yards away from the house and containing eight feet of water. That was *no good*. As a last resort we procured a copper boiler, attached thereto a copper wire, and sank the same in the above-mentioned well, and connected *all three grounds together*, with the same results as before. It did not work. Every wire that runs into the building or board is from one to three inches apart and perfectly insulated.

What is the matter, please?

W. H. C., Tel. Ex., Brattleboro, Vt.

It certainly seems as if all the requirements of a good ground had been fulfilled in this case, and one might be tempted to insist that the trouble must be elsewhere. However, the facts appear to us an indication that the trouble must be in that direction. Looking at the diagram above, we observe that there are three paths through which an impulse of current evolved on any one line may pass. Suppose we ring on line No. 1. The lines are all grounded at the remote end, of course. Consequently, the current on line No. 1, arriving at the line strip may pass either to the ground or return on lines Nos. 2 and 3, and then from their distal grounds to the ground of line No. 1; and of course the amount of current following each of these courses will be inversely proportional to its resistance. If the resistance of the switchboard ground is infinitely small, then the current should practically pass entirely by that route, which is the usual result with a normal ground. If, on the other hand, the resistance of this ground is high, then the current will return through the other lines in greater proportion, and only a small portion will pass through the office ground. This is what seems to happen in this case. It is plausible, therefore, that the grounds at the distal ends of the lines must be more favorably situated than that connecting with the switchboard.

The fact that the resistance of a ground connection may vary considerably with the nature of the soil and the geological peculiarities of the locality, is clearly shown by the following instance, which was recently related to us by Mr. F. W. Cushing, chief electrician of the Postal Telegraph Company. The Postal Telegraph Company's wire loops into a testing station at Fort Lee, on the Hudson, a distance less than a dozen miles from the New York office of the company. Fort Lee is situated at a high altitude on that steep rocky bank which extends for miles along the left side of the Hudson and which has been called the "Palisades of the Hudson," from its peculiar vertical indentations. It has proved a matter of serious difficulty to make good ground connections with this station thus located on a thick mass of rock. The tribulations of the electricians in charge make a good parallel of those detailed above. Stone or rock is of itself a very poor conductor; indeed, in the absence of moisture and heat, it is a very fair insulating material. Consequently it cannot be expected to prove very suitable "soil" for ground connections, especially when a hundred feet thick or more, and the testing station at Fort Lee proves it in a striking manner. The resistance of the ground connection at this station is found to be as high as the resistance of the company's wire from New York to Cleveland, or even greater, and communications can be maintained direct between New York and Cleveland even while the wire is grounded at Fort Lee. Mr. Cushing states that ground connections in rocky and mountainous regions often give trouble, and he cites an instance in his experience where it was found necessary to dig an artesian well to remedy the difficulty.

In the case of our correspondent, we would advise him to try the connecting of the lines to the ground, independently of the switchboard. It might be that the ground wire is imperfectly joined to the line strip. Then tell one subscriber to call, and see if the signal is still obtained on the other lines. If so, it must be that the ground is in a bad locality. It might be proper then to run a ground wire to some locality near one of the stations, where the grounds appear to be more perfect, and try the experiment with this ground. The results obtained would doubtless be interesting to others, and we should be pleased to be informed about them.

ELECTRICAL PATENTS ISSUED

And Dated April 24, 1883.

Conduit for electric wires; James A. Mehaffey, Parnassus, Pa	276,190
Dynamo-electric machine; Henry Roberts, Pittsburgh, Pa	276,194
Dynamo-electric generator; Charles C. Peck and William H. Chapman, Middlebury, Vt	276,275
Electric time register for telephone and telegraph switches; Frank E. Kinsman, New York	276,184
Electrical generator and motor; Thos. A. Edison, Menlo Park, N. J	276,233
Electrical switch-board; Christopher W. McLean, Newbern, N. C	276,263
Electric cut-out; Thomas H. Rhodes, Brooklyn, N. Y	276,286
Electric cut-out; Elroy M. Avery, Cleveland, O	276,328
Element for secondary batteries; Charles F. Brush, Cleveland, O	276,348
Means for operating and regulating electrical generators; Thos. A. Edison, Menlo Park, N. J	276,232
Magneto-electric generator; Charles C. Peck and William H. Chapman, Middlebury, Vt	276,274
Magneto and dynamo electric machine; Alphonse Isidore Gravier, Paris, France	276,390
Method of laying underground electric wires; Charles D. Shrieves and John E. Cook, Philadelphia, Pa	276,486
Push-button and circuit for lighting gas by electricity; Thos. H. Rhodes, Brooklyn, N. Y	276,285
Secondary battery; Charles F. Brush, Cleveland, O	276,155
Switch-board for electric circuits; Francis Blake, Weston, Mass	276,216
Secondary or storage battery; Eli T. Starr and E. Eugene Starr, Philadelphia, Pa	276,300-1
Underground line; Daniel N. Hurlbut, Chicago, Ill	276,415
Underground telegraph line; Nicholas M. Rittenhouse and Milo W. Locke, Baltimore, Md	276,472

BUSINESS NOTICES.

Mr. Geo. W. Whipple, No. 50 Exchange Place, this city, makes a specialty of telephone stocks. He also deals in electric light, telegraph and miscellaneous stocks.

Telephone companies or others desiring the services of an electrician of some experience will find an advertisement in another column by a gentleman who has given up an excellent position because his health demanded that he spend most of his time out-doors.

The *Penman's Journal* for April contains an interesting article on "the Pen's Part in Literature," as well as much other interesting matter of a more practical nature. Mr. D. T. Ames, the editor, has just issued a handsome Handbook of Artistic Penmanship, which is given as a premium with the *Journal* for a years' subscription.

The new substitute for hard rubber, known as gelatinized fibre, manufactured by Courtenay & Trull, of this city, is successfully making its way to the favor of electricians and electrical manufacturing companies. Messrs. Courtenay & Trull have removed from No. 17 Dey street to No. 15 of the same street.

The manufacturers of the Cummer engine are about to enlarge their works. The demand for their engines has become so pressing, orders constantly coming in from all the large cities, that increased facilities for their manufacture are absolutely necessary. Messrs. Hill, Clarke & Co., their agents in Boston, have recently sent orders for thirteen. Among the electric lighting companies who have lately ordered Cummer engines are the Brush Electric Light and Power Co., of Cleveland, O., for a 400 horse-power engine, and from the Brush Electric Light and Power Co. of Kansas City, Mo., for one of 150 horse-power.

The attention of persons interested in local telegraph and telephone organizations is respectfully called to the electric lighting system of THE FULLER ELECTRICAL COMPANY, and the practicability of making arrangements with that company for the introduction of its apparatus, either in isolated plants or through the formation of local companies desiring to engage in the business of electric lighting. The specially valuable features of this company's system may be seen by examination of its apparatus in Boston, Worcester, Providence, New York City, Brooklyn, Jersey City, Paterson, Philadelphia, Hartford, Lancaster, Scranton, Syracuse, Rochester, Buffalo, Pittsburgh, Wheeling, Steubenville, Xenia, Dayton, Grand Rapids, Chicago, Springfield, Belleville, St. Louis, St. Paul, and many other smaller places throughout the country. Correspondence is invited.

THE FULLER ELECTRICAL COMPANY,
44 East 14th street, New York City.

All Persons Sending for

Catalogues or ordering articles advertised in our columns will do us and our Advertisers both a great favor by mentioning that they saw the advertisement in

The Operator and Electrical World.

---

100 Japanese Napkins, 20 × 20. Best goods By mail, $1. G. W. LAKE, 74 Pine St., N. Y.

CARD COLLECTORS, Send 25 Cts. to HEARNE & CO., 11 FRANKFORT STREET, NEW YORK, for set of beautiful **Advertising Cards.**

CARDS Send two 3c. stamps for fine new set of "GILT PALETTES." WHITING, 50 Nassau St., N. Y.

HENRY COLLINS & CO., 79 NASSAU STREET, New York. JUST OUT—Our 12-page price list of postage stamps and albums, sent on receipt of three cents.

SHORT-HAND WRITING THOROUGHLY taught by mail. Terms low; satisfaction guaranteed. Send stamp for circular and specimen of writing.
W. W. HULTON, Stenographer, Pittsburgh, Pa.

MUSIC Without a Teacher. Soper's Instantaneous Guide to Keys of Piano and Organ. Price, $1. Will teach any person to play **20 Pieces of Music in One Day.** You couldn't learn it from a Teacher in a month for $10. Try it and be convinced. Sample copy will be mailed to any Address on receipt of 25 cts in Stamps by **HEARNE & CO., Publishers, 11 Frankfort St., New York.**

SHORTHAND AT YOUR HOMES.

COMPLETE INSTRUCTION in highest grade $20, and satisfaction assured in every respect. Send 10 cts. for specimens and terms.
R. B. CLARKE, Stenographer,
4637 Germantown Ave., Philadelphia, Pa.

THE PENMAN'S ART JOURNAL IS THE BEST AID TO GOOD WRITING PUBLISHED. SEND 3 THREE CENT STAMPS FOR A SINGLE COPY. OR $1.00 FOR ONE YEAR WITH PREMIUM. Address D. T. AMES, 205 BROADWAY. Writing Publisher, NEW YORK.

$100 A MONTH AND
$2 OUTFIT FREE.

AGENTS WANTED in every State to collect small pictures to copy and enlarge to a beautiful oil painting. The biggest thing out. Send for circulars, etc. Restorative Copying Co. Addresss N. WINSLOW & CO., 278 Bowery, New York.

1,000 OPERATORS WANTED.

Increased salaries. Secure agency for latest, most attractive and fastest selling books out, "Spy of the Rebellion," 700 pages marvelous spy work during the late civil war; "Professional Thieves and Detectives," 600 pages of thrilling adventures with notorious criminals; great part devoted to Telegraphy and Operators; profusely illustrated. Both books written by Allan Pinkerton, world-renowned detective. Circulars and terms free. K. S. V. RANDOLPH, Publisher, 315 Clifton Place, Brooklyn, N. Y.

BRIGGS & CO.'S

A *warm* iron passed over the back of these PAPERS TRANSFERS the Pattern to any fabric. Designs in **Crewels, Embroidery, Braiding** and **Initial Letters.**
New Book bound in cloth, showing all Briggs & Co.'s Patterns, including over 40 new designs, sent on receipt of seven 3-cent stamps.
104 FRANKLIN ST., N. Y.
Retailed by the leading Zephyr-Wool Stores.

Short-Hand Writing thoroughly taught by mail. Good situations procured all pupils when thoroughly competent. First-class stenographers furnished railroad officials without charge for my services. Correspondence solicited. Caligraphs sold. Special inducements offered operators and railroad officers. Send for COLLEGE REPORTER and caligraph circulars to W. G. CHAFFEE, Oswego, N. Y.

WANTED!

Situation as inspector or superintendent of electrical work, by a young man of three years practical experience. Owner of several electrical patents. Address "ELECTRICIAN," care of THE ELECTRICAL WORLD, No. 9 Murray Street, New York.

GEO. H. WHIPPLE,

58 Exchange Place, N. Y.

ELECTRIC LIGHT, TELEPHONE, TELEGRAPH
—AND—
Mscellaneous Stocks.

HALBERT E. PAINE, Late Commissioner of Patents. STORY B. LADD.

PAINE & LADD,

SOLICITORS OF PATENTS & ATTORNEYS IN PATENT CASES.
Washington, D. C.

FREE, If you will cut out this advertisement and send it to us we will mail to your address, **free,** our elegant illustrations of **18 K. Rolled Gold Solid Jewelry,** embracing **Rings, Lockets, Pins, Studs, Earrings, etc.,** of rich designs and **standard quality,** which we are now offering at the marvelously low special prices of **only one dollar each** in order to introduce our goods and catalogues everywhere. **Don't miss this extraordinary opportunity.** Address **Garside & Co.,** Manufacturing Jewelers, 239 Broadway, New York.

TELEGRAPH AND TELEPHONE POLES.

65,000 25 to 60 feet, No. 1 Quality.

These Poles are Live Timber, well seasoned, and in every way desirable. Deliverable on line of F. & P. M., Mack. Div. M. C., P. O. & Pt. Austin Railroads.

Electric Light, Railroad, Telegraph and Telephone Companies supplied. Prompt delivery.

HENRY C. RIPLEY,
EAST SAGINAW, MICH.

FREE GIFT.

We want 150,000 names of people living in small towns and on farms, to send our Catalogue of Novelties, useful Inventions and Publications to. We have determined to give to each person who sends us the names and address of five such people and **15** three-cent postage stamps (to pay for packing, postage and this advertisement) either of these elegant Stone Rings. They are made especially for us, and are elegant 14-karat Rolled Gold, with the best stones, Cameo and Foil Back Imitation Diamonds; they cannot be told from real gems unless examined by an expert with a file and by weight. Address

Agents' Supply Co.,
BROOKLYN, N. Y.

THE BEST TREE TRIMMER.

Adopted by the Western Union Co. and indorsed by all who use them.
Order one from your nearest hardware dealer, or from
Patterson Bros., 27 Park Row, N. Y.
L. G. Tillotson & Co., New York.
J. H. Bunnell & Co., New York.
Partrick & Carter, Philadelphia.
Standard Electrical Works, Cincinnati.
Circulars and description furnished on application.
E. S. LEE & CO.,
160 West Main St., Rochester, N. Y.

JOHN B. SABINE,

ATTORNEY AND COUNSELOR-AT-LAW, NOTARY PUBLIC
AND
PRACTICAL TELEGRAPHER.
102 Broadway, New York.

Special attention given to the *Law of Telegraphs;* to the incorporation of *Telegraph, Telephone and Electric Light Companies;* to all litigation arising in the construction and maintenance of lines; to the defense in all claims for errors and omissions in the transmission of messages, and for injuries resulting from the use of Electric light and other wires.

Letters patent obtained for all electrical inventions of merit in all countries.

Collections made for manufacturers and others.

Correspondence Solicited.

HOME MADE
TURKISH RUGS

By drawing in rags or worsted yarns, carpet filling, or ravelings into one of my stamped Burlap Patterns in Turkish Floral and Animal Designs. Easy and fascinating work. Send for circular; mailed free.
G. C. SCOTT, 22 New Church St., N. Y.
Cor. Cortlandt, Pearsall Building.

THE TIME TELEGRAPH COMPANY

IS PREPARED TO FURNISH
Railways, Business Blocks, Public Buildings and offices generally
WITH
UNIFORM STANDARD TIME
At a low monthly rental according to the location, style of Indicator, &c.
Address, **THE TIME TELEGRAPH COMPANY,**
TEMPLE COURT, 5 and 7 BEEKMAN ST., N. Y.

$40,000 IN PRESENTS GIVEN AWAY

The proprietors of the **FARM, FIELD AND FIRESIDE,** being desirous of having their already well-known and popular Agricultural and Family paper more widely circulated and introduced into houses where it is not already known, have determined to throw off all profit this year, and in addition use a portion of their capital for the sole purpose of increasing their circulation to **100,000** copies. After deciding to more extensively advertise than ever before, the following plan has been adopted by us.

FOR 50 CENTS

We will enter your name on our subscription book and mail the **FARM, FIELD AND FIRESIDE** regularly to you for Six Months and immediately send a **printed numbered Receipt,** which will entitle the holder to one of the following Presents to be given away at our **ANNUAL MIDSUMMER FESTIVAL.**

PARTIAL LIST OF PRESENTS TO BE GIVEN AWAY.

5 U. S. Government Bonds of $1000	$5000 00	1000 Pocket Silver Fruit Knives	$1000 00
10 U. S. Greenbacks of $500	5000 00	1000 Gents' Pocket Knives	1000 00
10 U. S. Greenbacks of $100	1000 00	1000 U. S. Greenbacks of $1 each	1000 00
1 Matched pair of Trotting Horses	1000 00	10 Gents' Gold Watches, English movement	800 00
1 Grand Square Piano	800 00	10 Ladies' " " " "	600 00
1 Grand Cabinet Organ	200 00	20 Boys' Silver " American "	200 00
1 Three-seat Rockaway	200 00	8 Solitaire Diamond Finger Rings	400 00
1 Silver Dinner Service	100 00	2 Patent Harvesters	1000 00
5 Top Buggies	1000 00	1 Normandy Work Horse	500 00
20 U. S. Greenbacks of $50 each	1000 00	2500 Elegant Oleograph Pictures	2500 00
1000 Photograph Albums $2 each	2000 00	5 Raw Silk Parlor Suit Furniture	1000 00
2 Village Carts	200 00	1460 Gold Finger Rings, Ladies' Breast Pins, Gents' Scarf Pins, Lockets, Fans & Chains	
1 Pony Phaeton	100 00		

And 92,935 other presents valued from 25 cents to $1.00, which makes a grand aggregation of 100,000 presents, thus guaranteeing **a present to each and every new subscriber** who sends us **50 cents** as directed.

All of the above presents will be awarded in a fair and impartial manner by committee chosen at the Festival by the Subscribers, and the presents will be awarded the same as at Church Fairs and Festivals. It will not be necessary for Subscribers to attend the Festival as presents will be sent to any part of the United States or Canada. Yet it is to be hoped as many will be present as possible. **THE 50 CENTS** which you send us is the regular price for Six Months' Subscription, and therefore we charge nothing for the presents. **OUR PROFIT** will be in your future patronage, as we believe you will like our paper so well that you will always remain a subscriber. **YOUR SUBSCRIPTION FREE.** Get five of your friends to join you by cutting this out and showing it to them. Send us **$2.50** and we will send you the **FARM, FIELD AND FIRESIDE** for six months, and a numbered receipt for each of your subscribers and one extra for your trouble.

SEND TEN SUBSCRIBERS with $5.00 and we will send **12** subscriptions and twelve numbered receipts.

30 DAYS ONLY. This offer will hold good for **30** days only, as we shall limit the number of new subscriptions to 100,000, so we would advise all our friends to forward subscriptions at an early date, as in no case will they be received later than **30** days from date of this paper.

THE FARM, FIELD AND FIRESIDE is one of the oldest and ablest edited Family and Agricultural papers. It contains **twenty large pages (Eighty Columns),** including elegant cover, bound, stitched and cut. It contains **Stories, Sketches, Poetry, Farm, Garden, Household and Agricultural Departments by the best Contributors of the day,** as well as an **illustrated Fashion Department, Needle and Embroidery Work.** Illustrations of different parts of the **United States** and **Biographical Sketches of Eminent Men and Women.** In short, it contains that which will interest, instruct and amuse the whole family.

THE PROPRIETORS are men of means, who always have done and always will do as they agree, and our paper is long established and reliable, with sufficient capital to carry out and fulfill to the letter any offer we may make.

TO THOSE WHO DO NOT ATTEND THE FESTIVAL we will send a printed List of the Awards, and all Presents will be forwarded to Holders of Receipts as they may direct.

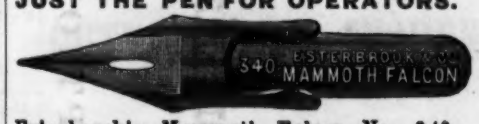
OUR OLD PATRONS AND SUBSCRIBERS, whom we number by the thousands, should at once go to work and help us to increase our List by this grand and generous offer.

ONLY 50 CENTS secures the **FARM, FIELD & FIRESIDE** Six Months, and a numbered receipt. The paper is worth double the subscription price. *As to our reliability we refer those who do not know us to any reputable Publisher in Chicago.*

Money in sums of $1.00 or less may be sent in ordinary letter at our risk; larger sums should be sent by Registered Letter or P. O. money order, and addressed to the **FARM, FIELD AND FIRESIDE,**
89 Randolph St., CHICAGO, ILL.

REMEMBER these are Presents to our Subscribers given to them absolutely Free. Cut this out and show to friends, acquaintances and neighbors, as it will not appear again. (Postage Stamps taken in sums less than $1.00.)

JUST THE PEN FOR OPERATORS.



Esterbrook's Mammoth Falcon No. 340.
LARGE ALL-WOOD PENHOLDERS TO SUIT.
Sample dozen Pens and Holder 40 cents.
THE ESTERBROOK STEEL PEN CO.,
Works, Camden, N. J. 26 John St., N. Y

CORNELL UNIVERSITY

COURSES IN
Electrical Engineering, Mechanical Engineering, Civil Engineering and Architecture

Entrance Examinations Begin at 9 A. M., June 18 and Sept. 18, 1883.

For the UNIVERSITY REGISTER, containing full statements regarding requirements for admission, courses of study, degrees, honors, expenses, free scholarships, etc., and for special information, apply to THE PRESIDENT of CORNELL UNIVERSITY, Ithaca, N. Y.

ARTISTIC NEEDLE WORK.

12 Elegant Darned Net Patterns; **50** Artistic Designs for Kensington Needle-work, such as sprays and bunches of Roses, Daisies, Pansies, Ferns, Apple-blossoms, &c.; **25** border Designs of flowers and vines, for Embroidering dresses and other garments; and **25** Elegant Designs for Corners, Borders, and centres for Piano-Covers, Table Covers, or Scarfs, Tidies, Lambrequins, &c.—all for **25** cents, post-paid.

Stamping Outfit of Ten full size working Perforated Patterns, consisting of Flowers, Corners, Borders, Outline Figures (see cut) Initial Letters, &c., with Powder, Distributing Pad, &c., **60** cents; with **15** Patterns, **$1.**

Our book, **MANUAL of NEEDLE-WORK,** &c., teaches how to do all kinds of **EMBROIDERY,** Knitting, Crocheting, Lace-making, Rug Making, &c., **35** cts; 4 for **$1.** All the above for **$1.** Address **PATTEN PUB. CO. 47 Barclay St. N. Y.**

HAINES BROS.,

Promoters and Brokers
55 BROADWAY, N. Y.
Electrical Stocks a Specialty.

1883. **$2.50**
New Electrical Directory.

Covers United States, Great Britain and the Continent.
Published for Berly by Dawson & Sons, London.
Com. Advertiser:—"No one with electrical interests can afford to do without it."
Mailed, registered, on receipt of $2.60.
Address CUMMING & BRINKERHOFF, General Agents, 219 East Eighteenth street, New York City.

THE BUTLER HARD RUBBER CO.

Electrical Supplies,
33 Mercer St., New York.
Manufacturers of
Sheet Rubber, Rods, Tubing, Etc.,
RUBBER HOOK INSULATORS.
Key Knobs, Switch Handles,
Magnet Covers, Magnet Heads,
Window Tubes, with Heads,
Battery Cells, Battery Syringes,
And Specialties of any Required Character.

$5,000 Accident Insurance. $25 Weekly Indemnity. Membership Fee, $4. Annual cost about $11. $10,000 Insurance, with $50 Weekly Indemnity, at Corresponding Rates. Write or call for Circular and Application Blank.
EUROPEAN PERMITS WITHOUT EXTRA CHARGE.
CHAS. B. PEET (of Rogers, Peet & Co.), **Pres.**
JAS. R. PITCHER, Secy.
320 and 322 BROADWAY, NEW YORK

WESTERN ELECTRIC COMPANY.

CHICAGO, NEW YORK. INDIANAPOLIS,

MANUFACTURERS OF

Telegraph Instruments and Supplies, Fire Alarms and Call Bells, Electro-Mercurial Hotel and House Annunciators, Burglar Alarms and Call Bells, Fire Alarm, Electric Gas-Lighting Apparatus, Magneto Call Bells, Telephone Exchange Switch Boards, etc.

UNDERGROUND AND AERIAL CABLES, AND TELEPHONE APPARATUS OF EVERY DESCRIPTION

CORRESPONDENCE SOLICITED.

$85.00

FOR ONLY

$45.00

FREIGHT PREPAID.

24 STOPS

5 Sets REEDS

LATEST STYLE, No. 1600.

Dimensions—Height, 74 ins., Depth, 26 ins., Length, 50 ins., Weight, boxed, about 450 lbs.

BEATTY'S PARLOR ORGANS ONLY $45.00

REGULAR PRICE, $85.00 Without Stool, Book & Music.

24 STOPS.—1. Cello, 8 ft. tone; 2. Melodia, 8 ft. tone; 3. Clarabella, 8 ft. tone; 4. Manual Sub-Bass, 16 ft. tone; 5. Bourdon, 16 ft. tone; 6. Saxophone, 8 ft. tone; 7. Viol di Gamba, 8 ft. tone; 8. Diapason, 8 ft. tone; 9. Viola Dolce, 4 ft. tone; 10. Grand Expressione, 8 ft. tone; 11. French Horn, 8 ft. tone; 12. Harp Æolian; 13. Vox Humana; 14. Echo, 8 ft. tone; 15. Dulciana, 8 ft. tone; 16. Clarionet, 8 ft. tone; 17. Voix Celeste, 8 ft. tone; 18. Violina, 4 ft. tone; 19. Vox Jubilante, 8 ft. tone; 20. Piccolo, 4 ft. tone; 21. Coupler Harmonique; 22. Orchestral Forte; 23. Grand Organ Knee Stop; 24. Right Organ Knee Stop.

☞ This Organ is a triumph of the organ-builder's art. IT IS VERY BEAUTIFUL IN APPEARANCE, BEING EXACTLY LIKE CUT. The Case is solid Walnut, profusely ornamented with hand-carving and expensive fancy veneers. The Pipe-Top is of the most beautiful design extant. It is deserving of a place in the millionaire's parlor, and would ornament the boudoir of a princess.

FIVE SETS REEDS.—Five Octaves, handsome appearance. It will not take the dirt or dust. It contains the Sweet VOIX CELESTE STOP, the famous French Horn Solo Combination, New Grand Organ Right and Left Knee Stops, to control the entire motion by the knee, if necessary. Five (5) Sets of GOLDEN TONGUE REEDS, as follows: a set of powerful Sub-Bass Reeds; set of 3 Octaves of VOIX CELESTE; one set of FRENCH HORN REEDS, and 2 1-2 Octaves each of regular GOLDEN TONGUE REEDS. Besides all this, it is fitted up with an OCTAVE COUPLER, which doubles the power of the instrument, Lamp Stands, Pocket for Music, Beatty's Patent Stop Action, also Sounding Boards, &c. It has a Sliding Lid and conveniently arranged Handles for moving. The Bellows, which are of the upright pattern, are made from the best quality of rubber cloth, are of great power, and are fitted up with steel springs and the best quality of pedal straps. The Pedals, instead of being covered with carpet, are polished metal of neat design, and never get out of repair or worn.

☞ Shipments of Beatty's Organs during the past four months, were as follows:

December, 1882, **1419** February, 1883, **1152** Total 5099
January, 1883, **1104** March, 1883, **1435**

The above is the largest number of Cabinet Organs shipped by any one house (for the same length of time) in existence.

SPECIAL TEN-DAY OFFER TO READERS OF THE OPERATOR.

If you will remit me $45.00 and the annexed Coupon within 10 days from the date hereof, I will box and ship you this Organ, with Organ Bench, Book, etc., exactly the same as I sell for $85. You should order immediately, and in no case later than 10 days. One year's test trial given and a full warrantee for six years. GIVEN UNDER MY HAND AND SEAL

DANIEL F. BEATTY WASHINGTON NEW JERSEY U.S. AMERICA

MAY 13, 1883.

Daniel F. Beatty

COUPON On receipt of this Coupon from any readers of **The Operator.** $40.00

and $45.00 in cash by Bank Draft, Post Office Money Order, Registered Letter, Express prepaid, or by Check on your Bank, if forwarded within 10 days from date hereof, I hereby agree to accept this Coupon for $40.00 as part payment on my celebrated 24 Stop $85 Parlor Organ, with Bench, Book, etc., providing the cash balance of $45.00 accompanies this Coupon, and I will send you a receipted bill in full for $85, and box and ship you the Organ just as it is advertised, fully warranted for six years. Money refunded with interest from date of remittance if not as represented after one year's use. (Signed) DANIEL F. BEATTY.

FREIGHT PREPAID. As a further inducement for you, (provided you order immediately, within the 10 days) I agree to prepay freight on the above Organ to your nearest railroad freight station any point east of the Mississippi River, or that far on any going west of it. This is a rare opportunity to place an instrument, as it were, at your very door, all freight prepaid, at manufacturer's wholesale prices. Order now; nothing saved by correspondence.

HOW TO ORDER. Enclosed find $45.00 for Organ. I have read your statement in this advertisement and I order one on condition that it must prove exactly as represented in this advertisement, or I shall return it at the end of one year's use and demand the return of my money, with interest from the very moment I forwarded it, at six per cent., according to your offer. ☞ Be very particular to give Name, Post Office, County, State, Freight Station, and on what Railroad. ☞ Be sure to remit by Bank Draft, P. O. Money Order, Registered Letter, Express prepaid, or by Bank Check. You may accept by telegraph on last day and remit by mail on that day, which will secure this special offer. I desire this magnificent instrument introduced without delay, hence this special price. *Providing order is given immediately.*

Address or call upon the Manufacturer } DANIEL F. BEATTY, Washington, New Jersey.

EYE STRENGTH AND BEAUTY.

For eyes tired, weak, overworked, spectacled or painful (or for nervous headache or neuralgia) there is no aid like the Knickerbocker Sight Preserver and Restorer. No liquids, no mechanical appliances. Circulars mailed free. Special price to first purchaser in a locality. ANDERSON & CO., 317 Broadway (Room 14), N. Y.

TO INVENTORS.

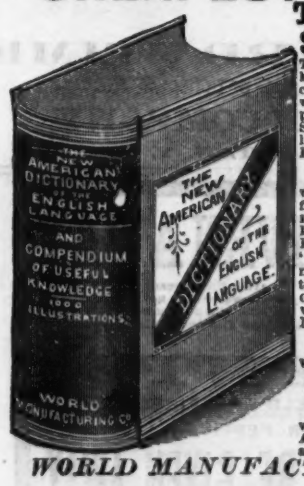
I make a specialty of taking out patents for

ELECTRICAL INVENTIONS

References and full information by mail on request. W. B. HALE, Solicitor of Patents. Former First Ass't Examiner in charge of Class of Electricity, U. S. Patent Office. Office, No. 614 F St., Washington, D. C.

CHEAPEST BOOK IN THE WORLD.

The New American Dictionary Price only $1.00.


THE NEW AMERICAN DICTIONARY OF THE ENGLISH LANGUAGE
AND COMPENDIUM OF USEFUL KNOWLEDGE
1000 ILLUSTRATIONS.
WORLD MANUFACTURING CO.

Contains 1,000 Engravings and 100 pages more than any other book of the kind ever published. This useful and elegant volume is a Library and Encyclopedia of general knowledge, as well as the best Dictionary in the world. Superbly bound in cloth and gilt. No pocket affair, but a large volume. It contains every useful word in the English language, with its true meaning, derivation, spelling and pronunciation, and a vast amount of absolutely necessary information upon Science, Mythology, Biography, American History, insolvent land and interest laws, etc., being a **Perfect Library of Reference.** Webster's Dictionary costs $3.00 and the New American Dictionary costs only $1.00.

Read what the Press Says:

"We have examined the New American Dictionary and find it is a very valuable book.—HOUSE & HOME. "We have never seen its equal, either in price, finish, or contents."—THE ADVOCATE. "Worth ten times the money."—TRIBUNE AND FARMER. "A perfect Dictionary and library of reference."—LESLIE ILLUSTRATED NEWS. "We have frequent occasion to use the New American Dictionary in our office and regard it well worth the price."—CHRISTIAN UNION. "With the New American Dictionary in the library for reference, many other much more expensive works can be dispensed with, and ignorance of his country, history, business, law, etc., is inexcusable in any man."—SCIENTIFIC AMERICAN. "A valuable addition to any library."—N. Y. SUN. "There is more real worth than in most books at ten times the cost."—N. Y. COMMERCIAL WORLD. Note the price, **$1.00**, post-paid; 2 copies for **$1.75**.

Extraordinary Offer. If any person will get up a Club of Ten, at $1.00 each we will send Free as a premium the American Waterbury Stem Winding Watch
For a Club of 15 we will send free a Solid Silver Hunting Case Watch.
For a Club of 30 we will send free a Lady's Solid Gold Hunting Case Watch.
For a Club of 50 we will send free a Gents' Solid Gold Hunting Case Watch.
Send a Dollar at once for a sample copy. You can easily secure one of these watches in a day or two, or during your leisure time evenings.
As to our reliability we can refer to the publishers of this paper, the commercial agencies or any express Co. in this city. Address

WORLD MANUFACTURING CO., 122 Nassau Street, New York

THIS SPLENDID COIN SILVER HUNTING CASE WATCH FREE

To any person who will send us —an order for—

15 NEW AMERICAN DICTIONARIES At One Dollar Each.

Any person can readily secure Fifteen subscribers in one or two hours, or in a single evening. If you want a good SOLID COIN SILVER WATCH and want to get it WITHOUT MONEY you can easily do so. Send ONE DOLLAR for a sample copy of the NEW AMERICAN DICTIONARY and see how easy you can get up a club of FIFTEEN.

If you don't care to get up a club yourself will you kindly hand this to some person whom you think would like to get the watch. 48 page illustrated catalogue FREE. Send money by registered letter or P. O. Money Order. Send all orders to WORLD MANUFACTURING CO. 122 Nassau Street, New York.

WORLD MANUFACTURING CO. November 21st, 1882.

Find enclosed $30 for 30 New American Dictionaries and the Ladies' Solid Gold Watch. I secured Thirty Subscribers in one day, and have several more promised. Everyone likes the Dictionary and all I have seen have subscribed.

Miss LAURA COIL, Annapolis, Mo.

Office of the Auditor of the Treasury, Post Office Department.
World Manuf'g Co., Washington, D. C., Jan. 29, 1883.

The New American Dictionary ordered January 15 at hand. I obtained fourteen subscribers in about as many minutes last Saturday, and find the Post Office department is a good field to work in. The book proves to be just the thing for office use. I have many more promised, and will send another larger order. Send the silver Watch as premium for this club.

[HUNDREDS OF TESTIMONIALS LIKE THE ABOVE] Respectfully, ROBERT H. WOOD.

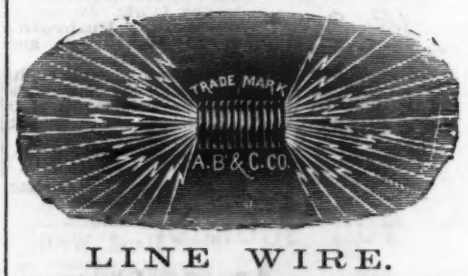
THE ANSONIA BRASS & COPPER CO.,

MANUFACTURERS OF

Pure Electric Copper Wire,

For Magnets, Telephones, Electric Lights, &c.

With H. Splitdorf's Patented Liquid Insulation, covered with Cotton or Silk.



LINE WIRE.

FIREPROOF HOUSE AND OFFICE WIRE FOR IN-DOOR USE IN ELECTRIC LIGHTING. Wrought Metal Gongs, for Annunciators, Telephones, &c.

ZINC RODS, BATTERY COPPER, &c.

Nos. 19 and 21 Cliff St., NEW YORK.

W. T. HENLEY'S TELEGRAPH WORKS COMPANY

(LIMITED),

Telegraph Engineers and Contractors
Wire Drawers and Galvanizers.

MANUFACTURERS OF

Submarine, Subterranean and Aerial Cables of every description, for Telegraph, Telephone and Electric Light Purposes.

Henley's Patent Oxkerited Core,
Henley's Patent Dynamo Machines
and Electric Lamps.

Estimates for any kind of cables or core furnished. OFFICE:
8 Draper's Gardens, Throgmorton Street, LONDON, ENGLAND.
WORKS: North Woolwich.

AGENTS IN THE UNITED STATES,

Western Electric Co., New York Chicago.

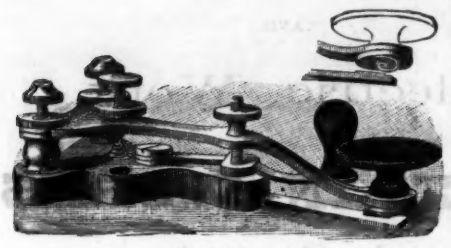
The Electrical Supply COMPANY.

The Prosch Telegraph Key

THE ONLY ABSOLUTELY

NON-STICKER

AND



(This cut is ⅓ size.)

EASY WORKER.

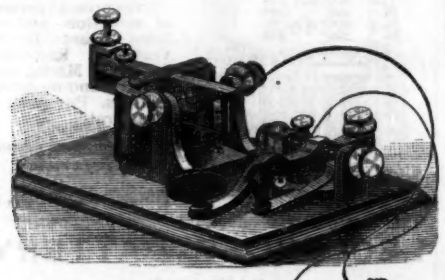
A Nickel Plated, with Platinum connections. Patented Nov. 19, 1882.

Price, - - $3.50.

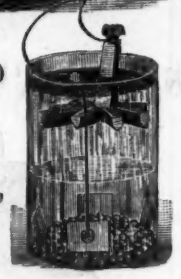
☞ Sent by registered mail.

FULL SIZE

Private Line Instrument.



No. 1 Outfit Complete, $3.50



No. 1 Key and Sounder only, $2.80.

COMPLETE OUTFITS BY EXPRESS.

KEYS AND SOUNDERS BY MAIL.

SOLE AGENTS FOR

THE UNITED STATES

FOR

PROFS. AYRTON & PERRY'S

Volt Meters, Ammeters, Ohm Meters.

SOLE AGENTS FOR

THE UNITED STATES

FOR

ELLIOTT BROTHERS'

(London)

Electrical Test Instruments.

SOLE AGENTS FOR

THE UNITED STATES

FOR

FRED'K SMITH & CO.,

GALVANIZED IRON

Telegraph and Telephone Wire.

Quotations and lists on application.

The Electrical Supply Co.,

109 Liberty Street,

NEW YORK.

DAY'S

KERITE INSULATED

Telegraph, Telephone and Electric Light

WIRES AND CABLES,

MANUFACTURED ONLY BY THE INVENTOR,

AUSTIN GOODYEAR DAY,

OFFICE: 120 BROADWAY, NEW YORK.

FACTORY: SEYMOUR, CONN.

KERITE INSULATION should be used on electrical conductors for any of the following purposes:

Submarine, Underground or Aerial Telegraph, Telephone and Electric Light Cables; Office Cables and Lines; also for Battery, Burglar Alarm, Fire Alarm, Police and Submarine Blasting Purposes,

or for any other operation which requires perfect, indestructible and permanent insulation of electric wires.

A large number of

ANTI-INDUCTION KERITE TELEPHONE CABLES,

some of them TWO MILES IN LENGTH, are in use in several cities, and are found to WORK PERFECTLY for that distance.

Kerite is recommended and indorsed by all leading men connected with telegraphy, telephony, and electric lighting.

At the CENTENNIAL EXHIBITION at Philadelphia, Sir WILLIAM THOMSON, the eminent Electrician and Scientist, awarded to the

Kerite Insulated Wire and Cables

A DIPLOMA

For "Excellence of the Insulation and Durability of the Insulator."

For Sale by all Dealers in Telegraphic Materials.

CLARK B. HOTCHKISS, Gen. Agt.

120 Broadway, New York.

CHARLES WILLIAMS, JR.

(ESTABLISHED IN 1856),

109 Court Street, Boston, Mass.,

AUTHORIZED MANUFACTURER OF

THE AMERICAN

BELL TELEPHONE CO.

Magneto, Crank and Push Button Call Bells, Electric Bells, District Bells and Switches for Exchanges, Annunciators, etc.

Telegraph and Electrical Instruments, Batteries, Wire, Insulators, and Telephone Supplies of every Description.

THE BISHOP

GUTTA-PERCHA WORKS.

ESTABLISHED IN 1847.

SAMUEL BOARDMAN, Agent.

Original and only Manufacturers in North America of

PURE GUTTA-PERCHA INSULATED,

SUBMARINE, SUBTERRANEAN AND AERIAL TELEGRAPH, TELEPHONE AND ELECTRICAL WIRES AND CABLES OF EVERY DESCRIPTION.

Sole Licensees under the Simpson patent for the manufacture of Gutta-Percha Insulated Wires. Have constantly on hand and make to order

GUTTA-PERCHA AND BALATA INSULATED WIRES FOR ALL ELECTRICAL PURPOSES, MARKS' COMPOUND INSULATED WIRES,

FOR OFFICE, AERIAL, UNDERGROUND AND BATTERY USES.

Also, every variety of Compressed Electrical Cordage—Burglar Alarm, Call Bell and Annunciator Wires—Electric Light and Gas Lighting Wires and Cables—Silk, Cotton and Fibre-covered Copper Magnet Wires and German Silver Resistance Wires—Medical, Switch and Telephone Cords—Flexible Elevator Cables, etc., G. P. Sheet for Cable Splices, and every description of pure

GUTTA-PERCHA GOODS.

OUR GOODS ARE FOR SALE BY

L. G. TILLOTSON & CO.,

5 and 7 Dey Street, New York.

Send for Catalogue.

ADDRESS COMMUNICATIONS:

W. W. MARKS, Supt.,

420, 422, 424, 426 East Twenty-fifth St.,

Office at the Works. NEW YORK CITY.

PHOSPHOR-BRONZE TELEPHONE WIRE.

"Phosphor-Bronze."

The STRONGEST, TOUGHEST and BEST for line wires of electric and acoustic telephones. Will not STRETCH nor RUST. RESISTS SMOKE, ACIDS and DAMPNESS. TENACITY more than FOUR times its weight per mile.

PHOSPHOR-BRONZE RODS, SPRING METAL AND WIRE,

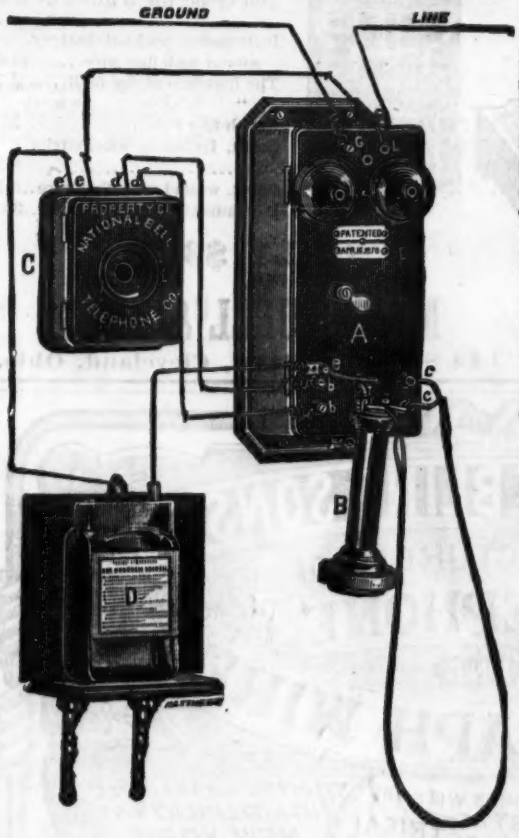
superior to German silver or brass for electrical apparatus. Already extensively used throughout the country. Address

THE PHOSPHOR-BRONZE SMELTING CO., LIMITED,
512 ARCH ST., PHILADELPHIA, PA.

Owners of the U. S. Phosphor-Bronze Patents. Sole Manufacturers of Phosphor-Bronze in the United States.

THE AMERICAN BELL TELEPHONE COMPANY.

W. H. FORBES, President. W. R. DRIVER, Treasurer. THEO. N. VAIL, General Manager.



This Company, owning the Original Patents of Alexander Graham Bell for the Electric Speaking Telephone, and other patents covering improvements upon the same, and controlling, except for certain limited territory, under an arrangement with the Western Union Telegraph Company, the Gold and Stock Telegraph Company, the American Speaking Telephone Company, and the Harmonic Telegraph Company, the patents owned by those companies, is now prepared to furnish, upon application, either directly or through any of its agents, Telephones of different styles, and applicable to a variety of uses.

This company desires to arrange with persons of responsibility for establishing

District or Exchange Systems,

in all unoccupied territory, similar to those now in operation in all the principal cities in this country.

Responsible and energetic persons are required to act as licensees for the purpose of establishing

PRIVATE LINE AND CLUB LINE

systems, for business or social uses. Also to introduce the telephone for

SPEAKING TUBE

purposes, for which instruments will be leased for a term of years at a nominal rental.

This Company will arrange for telephone lines between cities and towns where Exchange systems already exist, in order to afford facilities for personal communication between subscribers or customers of such systems.

We respectfully invite attention to this matter, and any further information relating thereto can be obtained from the Company,

No. 95 Milk Street, Boston, Mass.

All persons using Telephones not licensed by this Company are hereby respectfully notified that they are liable to prosecution, and for damages for infringement, and will be prosecuted accordingly to the full extent of the law.

FREE to every Reader

OF THIS Advertisement, A SPLENDID TIMEKEEPER.

In order to advertise HOUSE AND HOME, and secure subscribers promptly, we have decided to make the following most princely and magnificent offer to each and every reader of this paper. It is the common practice of the gold and silver refiners of England and Switzerland to purchase from the pawnbrokers of their respective countries all the gold and silver watches which have been unredeemed, simply for the sake of the gold and silver cases. The works are then sold to a celebrated watch firm who have made a specialty of this business. The firm places the works in the hands of skillful workmen, who set to work and put them in as good condition as possible. These works embrace every variety of movement, some of them being very fine and perfect timekeepers, all handsomely cased. *We have just purchased the entire stock* (25,000) of a bankrupt concern of the above described watches at less than the first cost of the raw material.

On receipt of **$1.50**, the subscription price of **House and Home**, and $1.00 extra to pay for packing, postage, and registering, we will send **House and Home** for one year (52 numbers), and one of these watches, POSTPAID, to any address in the United States. Watches mailed the day the order is received. The watches were purchased specially to go with **House and Home**, and will be furnished only to subscribers to that publication. In order to introduce it at once we make this unusual offer, which could not be made were it not for the fact that we bought the watches at one-quarter cost of manufacture.

On receipt of 50 cents extra we will send our new and elegant watch-chain, with a **Whistle Charm and Dog Call Attachment**—just the thing for hunters and sporting men.

MONEY RETURNED IF NOT AS DESCRIBED.

Address **METROPOLITAN PUBLISHING CO.,**
253 Broadway, New York City, N.Y.

WHAT THEY SAY OF US.

West Point, N. Y., Oct. 17, 1882. Metropolitan Publishing Company. Gents.: I am in receipt of the handsome premium watch sent me. I was much surprised to know that you could supply so good a timekeeper for so little money. HOUSE AND HOME alone is worth the price. Enclosed please find six (6) new subscriptions at $2.50. Please send me 6 premium watches, the same style as the last. Very truly yours, Lieut. E. S. Farrow, U. S. Army. **Murfreesboro, Tenn.,** Sept 30, 1882. Gents.: Watch arrived. * * * All right in time keeping qualities. Jesse W. Sparks, Jr. **St. Paul, Minn.,** Sept. 14. Premium received, and a nice one it is. Gen. R. W. Johnson. **Wrightstown, Minn.,** Sept. 20, '82. Received premium last night. Well satisfied. Martha Goodale. **South Gardiner, Me.,** Dec. 24, '82. Received watch and paper; like them much; was offered $10 for watch; don't want to sell. H. C. Goodwin. **Waverly, Pa.,** Feb. 16, '83. Received the beautiful premium watch. It keeps good time; our jeweler pronounced it coin silver. M. M. Huford. Testimonials like the above received every day.

**N. B.—The popular and beautiful weekly publication known as HOUSE AND HOME, illustrated newspaper (*established* 1880), is one of the best and most elegantly illustrated weekly newspapers of the day, full of News, Art, Science, Fashion, Music, Poetry, Charming Stories, Wit and Humor, Useful Knowledge, and Amusement for every American home. In fact, a pictorial history of the world from week to week—sixteen pages beautifully illustrated—same size as Harper's or Leslie's illustrated weeklies.

30 DAYS TRIAL. LITTLE GIANT FRENCH BATTERY.

Endorsed by the most eminent Physicians for the cure of **Rheumatism, Neuralgia,** and all Nervous Diseases and Weakness. Every Family should have one. A. B. Cameron, of Piedmont, Wy., says: "I have successfully managed to remove Rheumatism from my left knee to my left shoulder, and from my shoulder it is now gone to parts unknown to me, with the use of your 'Little Giant' Battery." Sent by express subject to inspection. Price complete, $6.00. Send for Circular.

AGENTS WANTED. **C. E. Jones & Bro., Electricians, Cincinnati, Ohio.**

HOOLE MANUFACTURING CO.

46 Bond St., New York.

HENRY W. GWINNER, *President.* WM. H. WOOLVERTON *Treasurer.*

This Company is prepared to furnish, at short notice, full lines of LIGHT RAILROAD AND FACTORY SUPPLIES. Communications and orders will receive prompt attention.

CHECKS.

BAGGAGE CHECKS, HOTEL CHECKS, RESTAURANT CHECKS, LAUNDRY CHECKS, BARBERS' CHECKS, POOL CHECKS.

BADGES.

Cap Badges, Breast Badges, Medals and Badges for Societies. Special designs furnished.

CONDUCTORS' PUNCHES.

BRASS TAGS.

Consecutively numbered and punched at end, or both ends, for use of Laundries.

UNIFORMS.

For Employés. Caps of every form, Canvas Caps, Cloth Caps, Sailor and Yachting Caps, Hats, Helmets, Sailor Suits, Jerseys, Buttons, with name of organization, monogram, or special designs.

HAND STAMPS.

ELECTRICITY!

EVERY FAMILY SHOULD HAVE ONE OF

DR. JEROME KIDDER'S

ELECTRO-MEDICAL APPARATUSES

THEY ARE THE BEST, owing to the Simplicity of Operation, Durable Construction and Physiological Qualities of Electricity they produce.

They have received from the American institute the highest awards from 1872 to 1882, inclusive; and in 1875 the Gold Medal, as an award of the first order of importance; also the Highest Award at the Centennial, Cincinnati Industrial Exposition (two Silver Medals) in fall of 1881 and two Silver Medals in 1882; Silver Medal at Charleston, S. C., Exposition fall of 1882.

Our machines are highly recommended by eminent Scientific Practioners, and give perfect satisfaction.

THE NO. 5 TIP BAT TERY APPARATUS.

(see cut) is the only complete and perfect portable apparatus. It does not require constant attention, and is operated by a form of battery that will remain active for months without replenishing the solution, and the annoyance and inconvenience due to crystalization in the cell is entirely obviated in the form of battery operating our

Faradic Machines.

Our machines are manufactured under **"Letters Patent" for marked and decided improvements.**

Rendering them SUPERIOR to any Manufactured, either here or abroad.

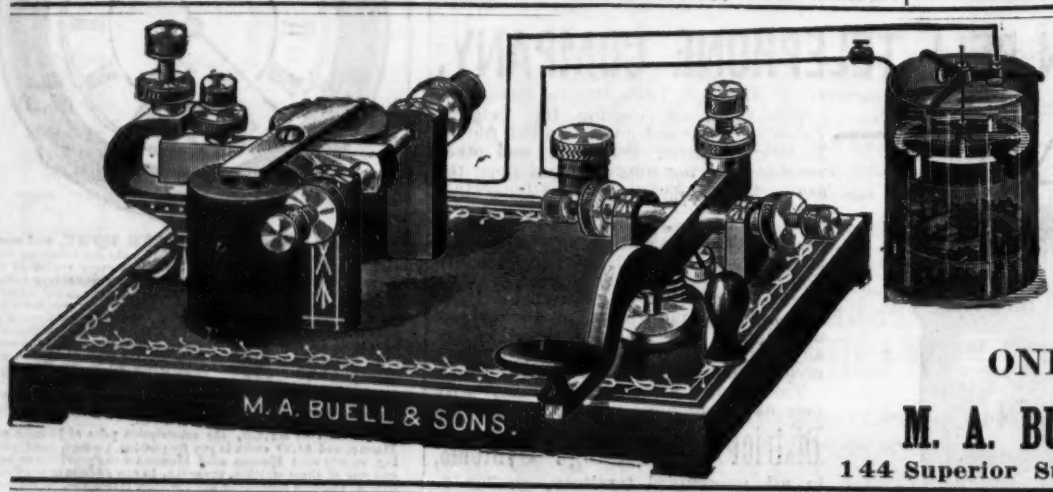
We manufacture a complete line of **Office FARADIC BATTERIES.**

ALSO

Cabinet, Galvanic, Galvano-Cautery, and Combined Galvanic and Faradic Apparatus, with Tip Cells or Upright Cells, as desired. **Galvanic Batteries.** from four to thirty-six cells constantly on hand. **Improved Pocket Induction Apparatus.**

All parties claiming highest awards are fraudulent, such claims being made to decive the public. All infringements will be prosecuted according to law, To distinguish the genuine from the spurious, send for Illustrated Catalogue. Address

JEROME KIDDER MANUFACTURING CO., 820 Broadway, NEW YORK.



THE STAR INSTRUMENT

Guaranteed to be Perfect and Good for 5 miles or less.

Instrument, without battery, wound with fine wire	$3.25
The Instrument, by mail	3.50
" " wound with fine wire	3.75
Outfit, including wire, vitriol, etc	3.50
Outfit, wound with fine wire	3.75
Instrument, without battery	3.00

ONLY $3.50.

M. A. BUELL & SONS,

144 Superior Street, Cleveland, Ohio.

The Works of the JNO. A. ROEBLING SONS CO., at Trenton, N. J., have facilities for producing large quantities Telegraph Wire on short notice. The Belgian system of rolling long lengths wire rods, and improved methods of galvanizing, were first introduced in the United States at these works. It insures the production of wire with few joints and with a thick coating of zinc.

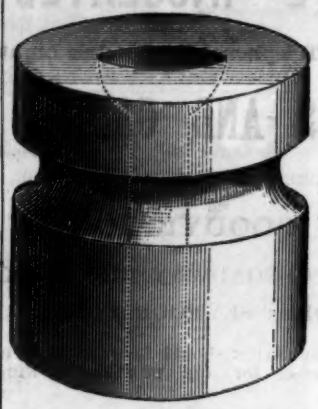
JOHN A. ROEBLING SONS CO.

MANUFACTURERS OF

TELEPHONE AND TELEGRAPH WIRE

WORKS AT TRENTON, N.J. ALL KINDS WITH THE HIGHEST ELECTRICAL CONDUCTIVITY OFFICE & WAREHOUSE 117 & 119 LIBERTY ST. NEW YORK.

Hard Porcelain Insulators,



LARGE AND SMALL,

FOR

Telegraph, Telephone

AND

Electric Work.

UNION PORCELAIN WORKS

300 Eckford Street,

GREENPOINT, N. Y.

ELECTRIC LIGHT TELEPHONE & TELEGRAPH SUPPLIES

WALLACE DIAMOND TRADE MARK

THE ELECTRICAL SUPPLY Co. 109 LIBERTY ST. NEW YORK

COMPLETE SETS OF MACHINERY

FOR THE MANUFACTURE OF

Telegraph Cables.

Wire Stranding Machines.

Complete sets of machinery for Purifying India Rubber and Gutta Percha, and Insulating Wire.

Lapping Machines for covering Wire with Silk, Cotton, Flax, Hemp, Tape, etc.

Thomas Barraclough & Co., Limited,

8 KING STREET,

Manchester, - - - England.

ENGLISH

Patent Office.

H. GARDNER,

166 Fleet St., London.

Successor to

Messrs. Robertson, Brooman & Co.

Gives prompt personal attention, and obtains Patents for Inventions, Protection for Trade Marks, etc., at fixed and moderate charges. Pamphlet of costs gratis.

Thirty years' practical experience.

Provisional Protection, £8

LECLANCHE BATTERY.

(PATENTED)

PRISM BATTERY, COMPLETE.
Size of Jar 6 × 4¼ inches.

GREAT TELEPHONE BATTERY.

The Realization of

SIMPLICITY AND EFFICIENCY

In Electric Open Circuit Batteries.

Free from acid. Emits no odor. Does not get out of order. Lasts without renewal from six months to several years, according to use.

ADOPTED AND USED BY THE

American Bell Telephone Company.

Metropolitan Telephone and Telegraph Company.

Western Union Telegraph Company.

Gold and Stock Telegraph Company, with their battery telephones.

And by all the Telephone Companies and Exchanges in the United States.

The attention of the public is called to the new form of Leclanché Battery, in which the porous cell is dispensed with and for it substituted a pair of compressed Placques or Prisms, which are simply strapped to the Carbon (as shown in cut). The Prism Battery is more easily and cheaply cleaned and renewed than any other battery. Beware of **Infringements and Worthless Imitations.**

Every genuine Leclanche Battery has the words Pile-Leclanche stamped on the carbon head, jar and prisms. All others are spurious.

"Prisms" and Porous Cell Batteries for sale in any quantity. Zinc and Sal Ammoniac of superior quality.

The Leclanche Battery Co.

149 West 18th St., New York.

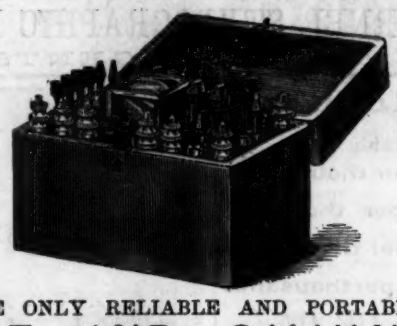
L. G. TILLOTSON & CO., Sole Agents

Nos. 5 & 7 DEY STREET, N. Y.

HOLMES, BOOTH & HAYDENS,
MANUFACTURERS OF
FIREPROOF INSULATED ELECTRIC LIGHT WIRE
From Pure Lake Superior Copper. Conductivity Guaranteed.
Patent "K. K." Insulated Copper and Iron Wire, for Telephone and Telegraph Use.
49 CHAMBERS ST., N. Y. WORKS: WATERBURY, CONN. 18 FEDERAL ST., BOSTON.

UNION ELECTRIC MANUFACTURING CO.,
Office, 145 Broadway, 86 Liberty St. NEW YORK. Factory, 7 and 9 Bond St.

Manufacturers of all kinds of instruments for Telegraph, Electric Light, Telephone, Burglar Alarm, Domestic, Gold and Stock and Medical use. District Call Boxes. Paper cut and wound any width for Registers, Printers and Ribbons.



Dealers in Electrical Supplies, Wires, Insulators, Battery Jars, Bells, Relays, Keys, Sounders, Paper Reels. Leclanché Battery complete or in parts and all other articles called for in the trade.

THE ONLY RELIABLE AND PORTABLE
WHEATSTONE BRIDGE AND GALVANOMETER COMBINED,
For Superintendents, Inspectors and Students. Fine Machines of all kinds made from models or drawings.
QUALITY OF WORK AND MODERATE PRICES CANNOT BE EXCELLED.

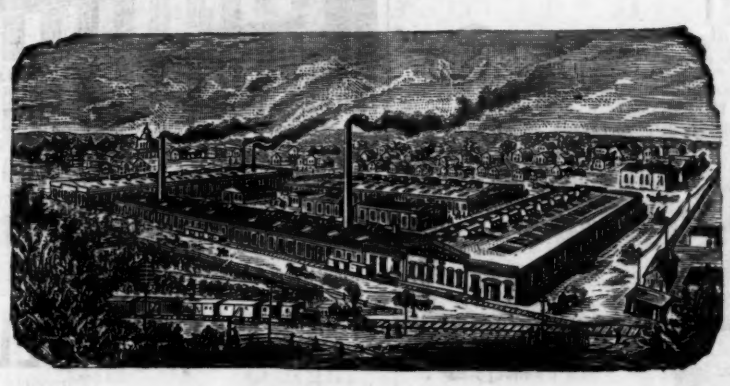
M. D. LEGGETT, Pres.
G. W. STOCKLY, V.-P. & Tr.
Business Manager.

The Brush Electric Company,

WM. F. SWIFT, Secy.
N. S. POSSONS, Supt.
W. J. POSSONS, Asst. Supt.

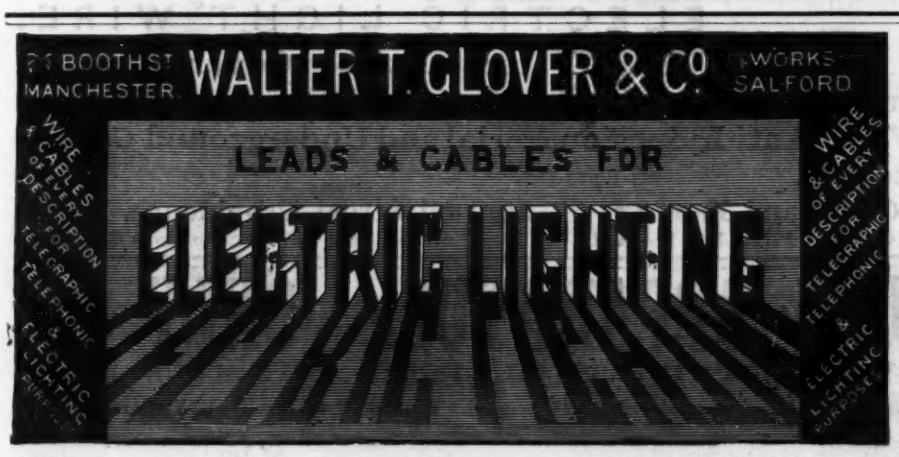
MANUFACTURERS OF

BRUSH
ELECTRIC LIGHT
MACHINES,
LAMPS AND CARBONS.



BRUSH
ELECTRO-PLATING
MACHINES, STORAGE BATTERIES
AND APPARATUS.

OFFICE, 379 EUCLID AVENUE. WORKS, MASON STREET CROSSING, C. & P. R. R.
CLEVELAND, OHIO, U. S. A.


BOOTH ST MANCHESTER
WALTER T. GLOVER & Co
WORKS SALFORD
LEADS & CABLES FOR
ELECTRIC LIGHTING
WIRE & CABLES OF EVERY DESCRIPTION FOR TELEGRAPHIC TELEPHONIC & ELECTRIC LIGHTING PURPOSES

Contractors to the English Postal Telegraph Department, Many Prominent European Governments, the Principal British Railway, Telephone and Electric Light Companies.
Estimates promptly furnished for all kinds of covered Wires and Cables for Shipment to America, on which specially low rates will be quoted.

25 Booth St., MANCHESTER, - - ENGLAND.

GEORGE WESTINGHOUSE, Jr., President. ROBERT PITCAIRN, Treasurer.
C. H. JACKSON, Vice President and General Manager. ASAPH T. POWAND, Secretary.
HENRY SNYDER, General Agent.

THE UNION SWITCH AND SIGNAL CO.,
PITTSBURGH, PENNA.,
A CONSOLIDATION OF
THE UNION ELECTRIC SIGNAL CO., AND OF THE INTERLOCKING SWITCH & SIGNAL CO.
Of Boston, Mass. Of Harrisburg, Pa.
SOLE OWNERS AND MANUFACTURERS OF THE ONLY PRACTICALLY SUCCESSFUL SYSTEM OF
OPERATING RAILROAD SIGNALS AUTOMATICALLY.
ALSO OF
APPARATUS FOR OPERATING AND INTERLOCKING SWITCHES, SIGNALS AND GATES BY LEVERS, HYDRAULICS, PNEUMATICS OR ELECTRICITY.
ALSO MANUFACTURERS OF
FROGS, CROSSINGS, SWITCHES AND SWITCH STANDS.

☞ Plans, estimates and detailed descriptions, together with references to apparatus in practical operation, will be furnished upon application.
Office and Works, Corner Fayette Street, Garrison Alley and Duquesne Way.

Yellow Cedar Telegraph Poles,
Railroad Ties, Paving Timber and Fence Posts for Telegraph, Electric Light, Telephone and Railroad Companies' Use.

The Michael Bay Lumber Co. (Limited) have on hand and cut to order Yellow Cedar Telegraph Poles, which will last from eight to ten years longer than white cedar or chestnut. Yard and office at Buffalo, Black Rock, N. Y. Standard poles, 25 feet, 6 inch top; 30 feet, 6 and 7 inch top, and long poles from 35 to 60 feet in car load lots from Black Rock, and by vessel loads at Lake Erie and Lake Michigan ports on the opening of navigation. Fifty thousand ready to deliver April and May. Correspondence solicited. All orders addressed to

A. A. COLBY, AGENT, BUFFALO, N. Y.,
Post Office Box 297 Will receive prompt attention

TELEGRAPH WIRE. TELEPHONE WIRE.
WASHBURN & MOEN MANUFACTURING COMPANY.
WORCESTER, MASS.

ESTABLISHED 1831. CAPITAL $1,500,000.
16 Cliff and 241 Pearl Street, New York.
215 Lake Street, Chicago.

This Company having given careful attention to Telegraph Wire from the introduction of the Art of Telegraphy, and especially with reference to the conditions necessary to *highest electric conductivity*, does not hesitate to recommend this class of its products as unequaled in that particular. Being the first to

MAKE A SPECIALTY OF TELEGRAPH WIRE,

and anticipating at an early day the great demand that would exist for that article, they have adopted and fully proved certain methods and appliances for the production of Telegraph as well as of Telephone Wire which are peculiar to themselves. Among them may be mentioned the
PATENT CONTINUOUS ROLLING MILL, PATENT CONTINUOUS GALVANIZING BATH, AND THE BELGIAN ROLLING MILL.
(In connection with the DOUBLE SIEMENS FURNACE).

All Wire made by this Company for Telegraph or Telephone purposes is thoroughly tested before shipping, with regard to Conductivity, Tensile and Torsion strength, as well as Elongation.
Prices and terms for Telegraph or Telephone Wire—Plain, Oiled or Galvanized—given upon application.
B. B.—The qualities known as extra Best (E. B. B.) and Best Best (B. B.) kept constantly in stock

TELEPHONE SERVICE

Without Induction and Mild, Clear Articulation.

Nos. 14 and 12 Spiral Wire for long and short lines.

American Spiral Telephone Wire Co., 43 Milk St., Boston, Mass., U. S.

J. H. LONGSTREET,

No. 9 Barclay Street,

NEW YORK,

MANUFACTURER AND DEALER IN

TELEGRAPH INSTRUMENTS,

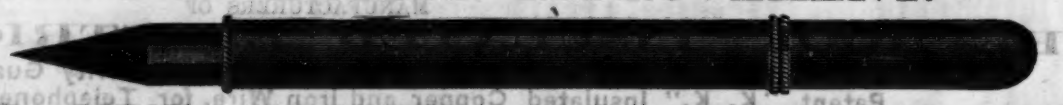
Telephone and Telegraph Supplies

OF EVERY DESCRIPTION,

ANNUNCIATORS AND BURGLAR ALARM APPARATUS, BATTERIES AND BATTERY MATERIAL.

Telegraph Instruments for Railroad Use a Specialty.

THE LATEST IMPROVEMENT.



THE NEW KERNER STYLOGRAPHIC PEN.

Indorsed by all telegraphists who have ever used it. Over 200 Sold in the NEW YORK CITY POST-OFFICE.

$1.00 $1.00 $1.00 $1.00 $1.00 $1.00 $1.00 $1.00 $1.00

For our No. 1 Pen, EQUAL TO THE BEST. No. 2, Handsomely Engraved, $1.25. No. 3, Gold Mounted, $1.50. No. 4, Gold Point, Cover Handsomely Chased, $3.00. Sent post-paid on receipt of price.

INCLOSE TEN CENTS EXTRA FOR REGISTRATION.

Address THE KERNER STYLOGRAPHIC PEN COMPANY, 25 Bond Street, New York.

AGENTS WANTED.

PINS AND BRACKETS.

We are now prepared to furnish

Pins, Plain, at $10 per thousand.

Pins, Painted, $11 per thousand

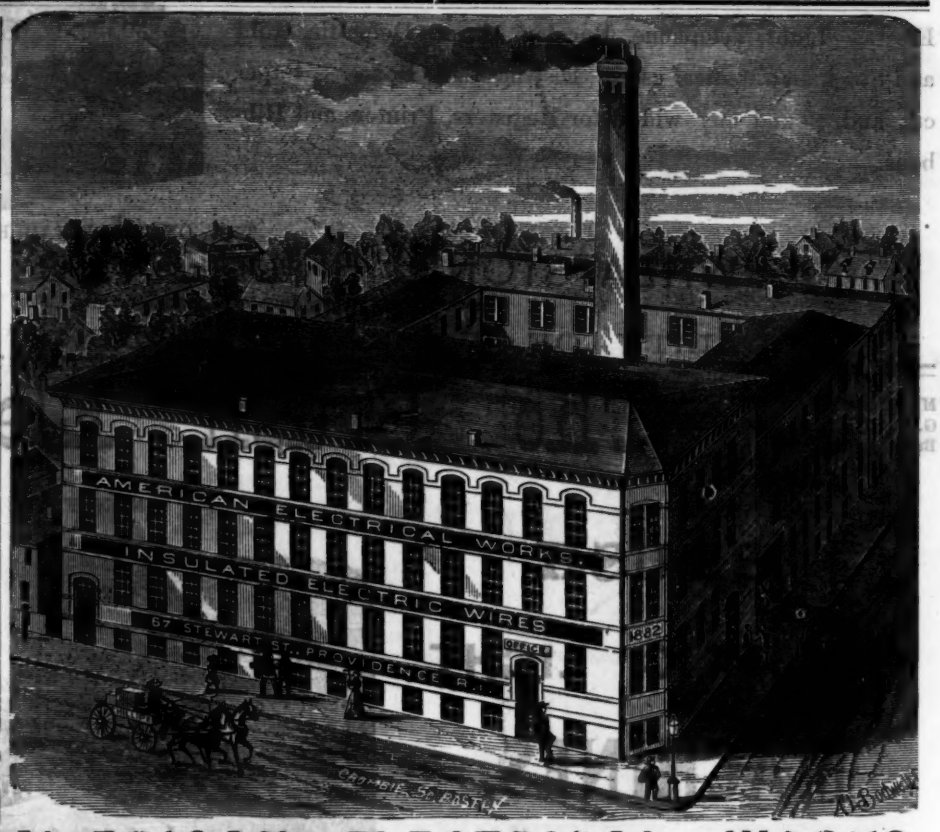
Brackets Plain, $13 per thousand.

Brackets, Painted, $15 per thousand.

BEST QUALITY OF OAK.

SPECIAL REDUCTION ON LARGE ORDERS.

L. B. HARRIS,
Manchester, N. H.



AMERICAN ELECTRICAL WORKS

(Formerly EUGENE F. PHILLIPS),
MANUFACTURERS OF

PATENT FINISHED

INSULATED ELECTRIC WIRES,
TELEPHONE AND ELECTRIC CORDAGE,
ELECTRIC LIGHT WIRE.

Magnet Wire, Patent Rubber-Covered Wire, Burglar Alarm and Annunciator Wire, Lead-Encased Wire; Anti-Induction Aerial and Underground Cables, etc., etc.

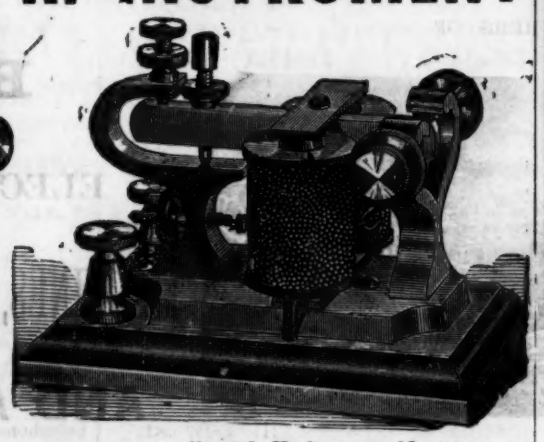
Office and Factory, 67 Stewart Street, Providence, R. I.

EUGENE F. PHILLIPS, President. W. H. SAWYER, Secretary and Electrician.

LYMAN'S O. K. INSTRUMENT

No. 2 O. K. KEY

The above Key is a perfect working key, and has *pure platinum points*. Price, $1.45, C. O. D., subject to inspection.



No. 2 O. K. SOUNDER.

The above Sounder is warranted to work well where any sounder will. Price, $2.60, C. O. D., with privilege to examine before paying for it.

The above Sounder and Key (either on one base or separate, as ordered), one full-sized Callaud battery, 1 lb. vitriol, 15 ft. office wire, etc., all nicely packed and sent C. O. D., $4.50, with privilege to examine before paying for them.

These instruments are neat in appearance, strong and durable. The bases of the key and sounder are iron, japanned, and nicely ornamented with gold leaf. The levers are iron, bronzed, and look as well as brass. All the screws, check-nuts, binding-posts, etc., are of brass, nicely finished. The contact points in the key are *pure platinum*. The sounder magnets are full size, and wound to work on a line from a few feet to 10 miles without relay.

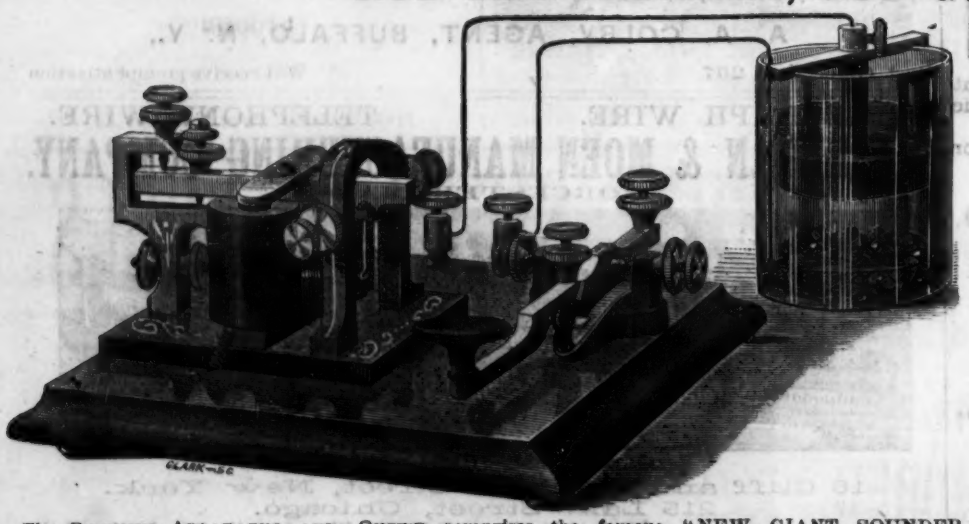
If you want cheaper instruments, send for my reduced price list, which I mail free of charge. Will fill all orders the same day I receive them. Address, mentioning THE OPERATOR,

A. B. LYMAN,

39 SOUTH WATER STREET, - - CLEVELAND, O.

PARTRICK & CARTER'S PREMIUM APPARATUS. ONLY $5.

NOT THE CHEAPEST, BUT GUARANTEED THE BEST.



The PREMIUM APPARATUS AND OUTFIT comprises the famous "NEW GIANT SOUNDER PERFECTED," and the "NEW CURVED KEY," placed upon a splendidly polished base, with a cell of Callaud Battery, Chemicals, Office Wire, etc., for $5, when the money accompanies the order.

Price, Complete Outfit	Money in advance		$5.00
" Instrument without Battery	"	"	4.20
" " wound with finer wires for lines of one to 15 miles	"	"	5.00
" Cell of Battery, Complete	"	"	.80
" Premium Sounder, Separate Base	"	"	2.50
" " Key, " "	"	"	1.75
" Premium Instrument, Key and Sounder entirely Nickel-plated, without battery	"	"	5.20
" Complete Nickel-plated Instrument, with battery and outfit	"	"	6.00
" " " Sounder Separate Base	"	"	3.25
" " " Key " "	"	"	2.00

Instruments without battery, sent by mail, 55 cents extra. Battery jars cannot be sent by mail.

All orders will receive our prompt and careful attention. To prevent delay in shipment, full shipping instructions with town, county and State, should be given. Remittances should be made by P. O. money order, registered letter, draft or express, which will insure safe delivery. Send for catalogues and circulars before purchasing elsewhere.

These instruments are the exact size and form of those upon which we received the highest award at the late Centennial Exhibition over all competitors. Everything reliable, and so guaranteed, or money re-funded.

Since the introduction of the "Premium" Instruments we have sold thousands of them, and in every instance they have given entire satisfaction, whether used for home practice or for actual work on lines from 1 to 20 miles in length. As an evidence of their popularity and acknowledged superiority, we append a few extracts from the hundreds of testimonials we have received.

"Sorry I did not know of the Premium before, as I had bought several, which are inferior to yours." WILL H. MITCHELL, Grass Valley, Cal.

"I have eight Premiums working splendidly on a line 1 mile long, with 7 cells battery.', ORION SIGGENS, West Hickory, Pa.

"The Premium Instrument is superior to all, and you may be sure of further orders." O. J. ALLARD, Glad Brook, Iowa.

"The Premium works splendidly; did not think it could be made so well and sold so low." JOS. K. MAXWELL, Tuscaloosa, Ala.

"I have worked them on main line 35 miles long. I consider them very superior Instruments." E. J. OCUMPAUGH, Orleans, N. Y.

The "PREMIUM" is the Cheapest, because it is the BEST.

PARTRICK & CARTER,

Established 1867,

MANUFACTURERS OF TELEGRAPH INSTRUMENTS AND SUPPLIES,

No. 114 South Second Street, Philadelphia.

FRANK H. SKEELE,

BROKER,

55 Broadway,

NEW YORK.

Telephone and Telegraph Stocks a Specialty

Gelatinized Fibre.

(Trade Mark.)

The New Substitute for Hard Rubber.

Adopted by the leading Electric Light Companies and Manufacturers of Electrical Apparatus, being a better non-conductor, lighter and more durable, at half the cost.

Send for samples, circulars and prices to

COURTENAY & TRULL,

No. 17 Dey St., New York.

WHEN YOU WANT

Fire Insurance,

WRITE TO

JOSEPH E. CRAWFORD,

MOUNT VERNON, N. Y.,

Representing eight Fire Insurance Companies, also the "Travelers," of Hartford, Conn.

BOSTON AND SANDWICH

GLASS CO.

OFFICE AND SAMPLE ROOMS,

No. 17 MURRAY ST., N. Y.

REPRESENTED BY

C. E. L. BRINKERHOFF.

CHESTER & CO.,

22 New Church St., N. Y.

Formerly C. T. & J. N. Chester, 104 Centre St.

Consulting Engineers and Electricians.

Special attention given to developing inventions and securing patents. Expert advice given; every class of electro mechanical construction attended to, and all classes of electric supplies furnished. P. O. Box 2766.

CHARLES L. BLY

(Successor to STEARNS & GEORGE),

TELEGRAPH AND TELEPHONE LINE CONTRACTOR,

Manufacturer and Dealer in

Electrical Instruments and Supplies, Burglar Alarms, Electric Bells, Annunciators, Watch-Clocks, and Electric Gas Lighting,

37 PEARL STREET, BOSTON, Mass.

Telegraph and Telephone Poles

(Cedar, Spruce or Chestnut).

PINS AND BRACKETS

(Painted or Plain).

Construction of Tel. Lines.

GEO. Q. DOW, North Epping, N. H.

CEDAR TELEGRAPH POLES.

LIGHT POLES FOR TELEPHONE LINES AND LONG POLES FOR CITY USE CONSTANTLY ON HAND.

50,000 Split Cedar Posts on Hand Ready for Immediate Delivery.

BROWNLEE & CO.,

Detroit, Mich.

PARTRICK & CARTER,

(ESTABLISHED 1867)

NO. 114 SOUTH SECOND ST.,

PHILADELPHIA, PA.,

MANUFACTURERS OF AND DEALERS IN

Telegraph Instruments, Telephone and Electric Light Supplies,

HOTEL AND HOUSE ANNUNCIATORS

BURGLAR ALARMS, CALL BELLS,

BATTERIES, OFFICE, ANNUNCIATOR, AND LINE WIRES, ETC., ETC.

SUPPLIES OF EVERY DESCRIPTION.

PRICES AS LOW AS THE LOWEST.

Send for Catalogues and Circulars.

IN WRITING TO ADVERTISERS,

Always mention that you saw their advertisements in

THE ELECTRICAL WORLD.

THE CARBONS

MANUFACTURED BY THE

American Carbon Co.,

ST. LOUIS, MO.,

Are Warranted the Best

FOR ELECTRIC LIGHTS.

L. G. TILLOTSON & CO.,

AGENTS,

5 and 7 Dey Street, N Y.

DELANO & HAINES,

Promoters and Brokers,

TEMPLE COURT,

5 BEEKMAN ST., N. Y.

EXECUTIVE OFFICES OF THE

MEXICAN TELEPHONE CO., AND THE TROPICAL AMERICAN TELEPHONE CO., LIMITED.

These companies have acquired and own, in their respective territories, all the telephonic rights formerly the property of the Continental Telephone Co., including the *exclusive right*, for a term of years, of selling, leasing, and using Bell Telephones, Blake Transmitters, and all other telephonic apparatus manufactured by the AMERICAN BELL TELEPHONE CO., under patents owned or controlled by it in the United States and Canada.

VALUABLE TELEPHONE TERRITORY

Can be had by parties who can furnish the money requisite to develop it, in the Republic of Mexico, the West India Islands, and South America.

TELEPHONE AND ELECTRICAL

STOCKS

BOUGHT AND SOLD.

Iron Telegraph & Telephone Wire,

MANUFACTURED BY

Fred'k Smith & Co.,

HALIFAX, - ENGLAND.

Wire Delivered on Board in Liverpool for Shipment to any Part of the World,

OR FROM STOCK IN NEW YORK,

Or in Bond, or Duty Paid in any Part of the United States.

Full particulars, quotations in sterling or currency, and tables and samples on application.

THE ELECTRICAL SUPPLY CO.,

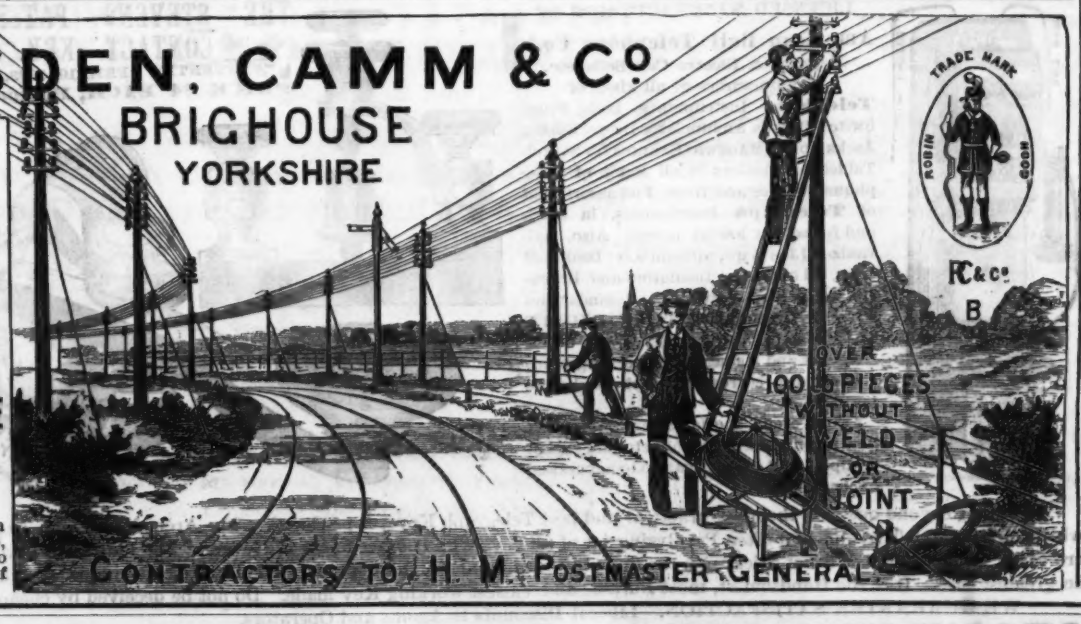
Sole Agents for the United States,

109 Liberty St., N. Y.

RAMSDEN, CAMM & Co

BRIGHOUSE

YORKSHIRE



MANUFACTURERS OF PATENT

Telegraph Wire

To Government Specifications.

BEST REFINED

Telephone Wire,

FENCING WIRE,

SUBMARINE CABLE WIRE

Strand & Stay Wire,

AND

Galvanized Binding Wire.

Correspondence solicited from American Telegraph, Telephone, Railway and other companies, also contractors, etc., using quantities of wire.

MAGNETO AND BATTERY SIGNAL BELLS.

We have a large number of second-hand Magneto Bells, without the Telephone switch or connections, for sale at extremely low prices.

These bells are admirably *adapted for Stable, Hotel, Restaurant* and many other purposes where a call bell of any sort would be of service for signaling or summoning all kinds of employés, servants, etc.

They will ring on any length of line and give a clear and distinct sound. THE GREAT ADVANTAGE in using such an instrument is, *YOU CAN SIGNAL BACK.*

NO BATTERY IS REQUIRED.

No Skill Necessary to Set up or Operate Them and Always Reliable.

PRICE, $4 EACH. DISCOUNT ON LARGE LOTS.

We have a lot of these very handsome altered Telephone Bells, and will sell them at less than cost of manufacture.

They are wound to 30 ohms resistance; silk-covered wire nickel-plated bell, 3½ inches diameter, and working parts covered with nickel-plate case.

Price, vibratory..... $1.75 each.

" single stroke..... 1.60 "

WORTH TWO ORDINARY BOX BELLS AT TWICE THE PRICE.

DAVIS & WATTS, Baltimore, Md.,

Manufacturers and Dealers in all kinds of

ELECTRICAL AND TELEPHONE INSTRUMENTS AND SUPPLIES.

QUOTATIONS PROMPTLY AND CHEERFULLY FURNISHED.

TELEPHONES!

For private lines. Latest, best; always reliable; work 2 miles on cable-wire. Illus. Circulars free. Holcomb & Co., Cleveland, O.

The Only One-Man Car Made.

The Patent Velocipede Hand Car.

Used on more than 150 Railroads.

Large Numbers Exported.

Runs Easily, is Durable and Capable of High Speed. Circulars and indorsements of prominent railroads sent on application.

GEO. T. SHEFFIELD & CO.,
Sole Manufacturers,
Three Rivers, Mich.

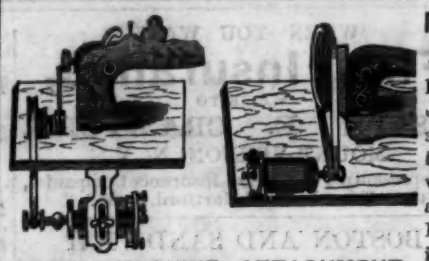
ESTABLISHED 1859.

PLATINUM.

H. M. RAYNOR,
25 BOND STREET, New York.

BOOKS.

Descriptive Catalogue of Books relating to practical science—90 pages—and Catalogue of Electrical Books—12 pages—sent free by mail on application.
E. & F. N. SPON, 44 Murray St., N. Y.



SEWING-MACHINE ATTACHMENT.

THE Double Induction ELECTRIC MOTOR

THE AUTOMATIC BATTERY

For FAMILY sewing-machines; dental, jewelers' and watchmakers' lathes, fans, etc., etc. Motor, with automatic battery and complete outfit for FAMILY sewing-machines, $35.00 to $40.00.

Double Induction Motors, Dynamo Machines, Automatic Batteries, Experimental Apparatus, etc. In writing for illustrated catalogue, give street and number.

THE ELECTRO DYNAMIC CO.,
19 E. 15th St., New York. 121 South Third St., Philadelphia. Cannon St., London, Eng.

ATLAS POWDER.

(A NITRO-GLYCERINE COMPOUND.)

The strongest and most reliable of the many compounds generally termed high explosives, and conceded by every one of experience to be the *safest* to handle and transport under all conditions.

Put up in cartridges of nine different grades, and of various diameters and lengths, and packed in boxes holding 50 pounds and 25 pounds.

For sale in all sections of the country by the authorized Agents of

E. I. DUPONT DE NEMOURS & CO., WILMINGTON, DEL.
LAFLIN & RAND POWDER CO., NEW YORK.
HAZARD POWDER CO NEW YORK.

Manufactured by the REPAUNO CHEMICAL CO., 305 Walnut Street, Room G, P. O. Box 2,472, PHILADELPHIA.

THE "ELGIN" (ACOUSTIC) TELEPHONE.

$5.00. FOR PRIVATE LINES. $5.00.

COPIED BY MANY, EXCELLED BY NONE.

The only Mechanical Telephone Adapted to Exchanges.

MADE WHOLLY OF METAL, NICKEL PLATED. WILL STAND ANY CLIMATE. SELF ADJUSTING. THE ONLY MECHANICAL TELEPHONE WHICH FULLY "FILLS THE BILL."

Parties who have exercised all their patience and who have become completely discouraged with their ill success with other Acoustic Telephones, will find in the "ELGIN" a "boon."

LARGE AMPLIFYING TELEPHONES (patented), using STEEL GALVANIZED WIRE for long lines, only $8.00 per set. Descriptive Circulars sent on application.

ELGIN TELEPHONE CO., Elgin, Kane Co., Ill., U. S. A.

G. W. HUBBELL, Pres. THE AMERICAN F. T. FEAREY, Sec. and Tr.

ELECTRIC STORAGE COMPANY.

The patents and inventions owned by this company, including those of NATHANIEL S. KEITH, cover the **fundamental principles** in the manufacture and use of what are known as **Secondary or Storage Batteries, Accumulators, or Electric Reservoirs,** and have *priority over all others in the United States.*

Our Reservoirs were invented some years since, and then embodied all the *essential features of the storage batteries or accumulators* of the present day. We are now contesting the question of priority of invention with Faure, Brush and others.

We offer for sale valuable territory rights in the United States.

Responsible parties can make favorable arrangements with us at the present time; perhaps more so than when the work is more fully developed.

Proper references should always accompany applications. Address all communications to

THE AMERICAN ELECTRIC STORAGE COMPANY,
792 BROAD ST., NEWARK, N. J.

THE FAURE ACCUMULATORS OR ELECTRIC STORAGE BATTERIES.

The heretofore missing link in Electric Lighting. No machinery of any kind required on or near the premises.

The light produced from these batteries is always ABSOLUTELY STEADY and pure and free from the FLICKER or PULSATION that is apparent in every light coming direct from a dynamo.

The consumer is *free from the uncertainty of steam power*, and the liability of all kinds of machinery to *stop* at the most inopportune moment. These batteries enable a *vast saving of money*, both in introducing and in after use, besides affording *heretofore* unknown comfort in the use of electricity.

They are Applicable for Power as well as Light.

For the privilege to *organize companies* under this patent, or for the purpose of *isolated* plants in any of the following States:

Virginia, North Carolina, South Carolina, Alabama, Georgia, Florida, Texas, Louisiana, Mississippi,

Application may be made to

DAVIS & PROAL,
BALTIMORE, Md.,
Rooms 29 and 31, Chamber of Commerce Building,

who are the managers for the Parent Company in the above named States, and who are empowered in its name to *issue licenses.*

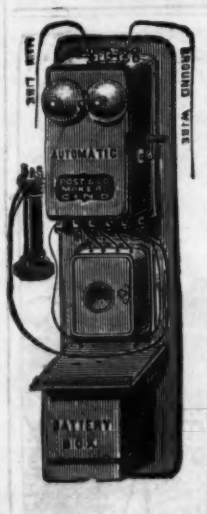
They will be pleased to give any information regarding the system.

The batteries are in practical use in the Chamber of Commerce Building, and in our offices, where the entire working of the system can be seen and explained.

All communications will have immediate attention.

AUGUSTUS G. DAVIS, A. B. PROAL.

STANDARD ELECTRICAL WORKS.

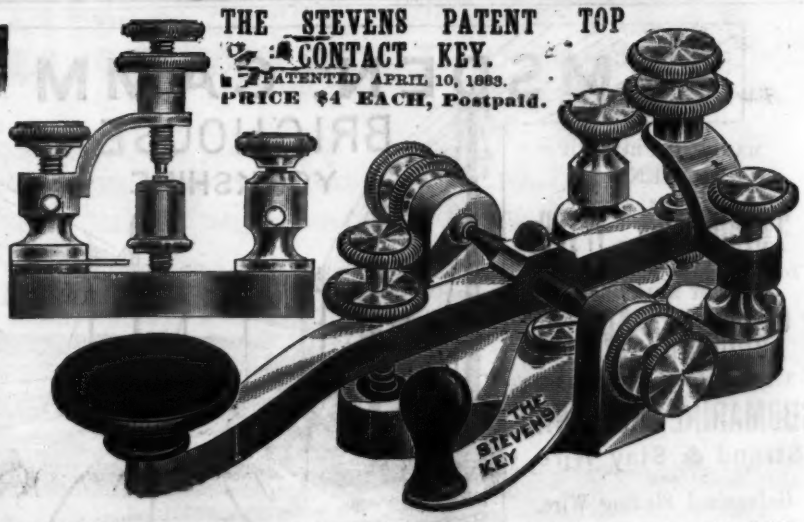


LICENSED MANUFACTURERS OF
American Bell Telephone Co.'s
Magneto & Electro Call Bells, etc.
Manufacturers of all kinds of
Telephone Instruments, Bells, Plugs Switch-Boards, Annunciator Drops, Spring Jacks, POST'S MAGNETO ENGINES for Switch Tables, and dealers in all kinds of Telephone supplies and Tools. Full assortment of **Telegraph** Instruments, in stock and for sale at lowest prices. Also, Galvanized Line Wire, all numbers; Insulated Wire, all numbers; Insulators and Brackets, all sizes; Batteries, all kinds and sizes; full line **ELECTRIC LIGHT** SUPPLIES, at lowest rates.

Agents and Managers of Exchanges are requested to correspond with us before purchasing.

☞ We call special attention to our new improved Post's Magneto Call Bells. Samples sent on application to agents and exchanges.

THE STEVENS PATENT TOP CONTACT KEY.
PATENTED APRIL 10, 1883.
PRICE $4 EACH, Postpaid.



This is beyond question the most practical and best Telegraph Key yet produced. The Arched Arm and Top Contact secure, a flexibility which obviates the Tiresome and often Paralyzing jar of all keys with contact under the lever. The Platinums never batter down, last for years are easily replaced, and will not Stick with the finest adjustment and highest speed. The Leverage is unique, and produces very firm writing with he greatest ease. It is the Handsomest, most Durable and easiest working Key made. Do not be deceived by cheap and worthless keys.

WE GUARANTEE SATISFACTION. Liberal Discounts to Agents and Operators.

STANDARD ELECTRICAL WORKS, CINCINNATI, O.

THE UNITED STATES ELECTRIC LIGHTING COMPANY,

EQUITABLE BUILDING No. 120 BROADWAY, NEW YORK.

Complete Systems of Arc and Incandescent Electric Lighting Apparatus.

This Apparatus Combines the Highest Electrical Efficiency with the best Mechanical Design, and is unequaled for

ECONOMY, SAFETY,
SIMPLICITY
AND THE
QUALITY OF LIGHT PRODUCED.

DYNAMO MACHINES,
ELECTRIC MOTORS,
ARC LAMPS,
INCANDESCENT LAMPS,
STORAGE BATTERIES,
CARBONS, Etc., Etc.

Estimates Furnished on Application.

Send for Illustrated Catalogue.

GEO W HEBARD, President.
L. E. CURTIS, Secretary.

TRUSTEES:

M. HARTLEY, A. P. STOKES, CHAS. R. FLINT, R. B. MINTURN, G. W. HEBARD, H. B. HYDE, L. FITZGERALD, W. T. BATCH, J. H. HUBBARD, T. A. [illegible]